DOMESTIC HYGIENE

INCLUDING SOME GENERAL PROBLEMS
AFFECTING THE PUBLIC HEALTH

BY

ARNOLD WINKELRIED WILLIAMS
M.B., C.M.(EDIN.), D.P.H.(LOND.)

LONDON: GEORGE BELL & SONS
YORK STREET, COVENT GARDEN
1898

PRICE ONE SHILLING.

DOMESTIC HYGIENE

DOMESTIC HYGIENE

INCLUDING SOME GENERAL PROBLEMS AFFECTING THE PUBLIC HEALTH

BY

ARNOLD WINKELRIED WILLIAMS
M.B., C.M.(Edin.), D.P.H.(Lond.)

LONDON: GEORGE BELL & SONS
YORK STREET, COVENT GARDEN
1898

TO THE MEMORY

OF

MY DEAR FATHER

(W. MATTIEU WILLIAMS)

WHOSE LIFE WAS GIVEN TO THE
SPREAD OF SCIENTIFIC KNOWLEDGE
AMONGST MEN OF ALL CLASSES

I DEDICATE THIS BOOK

AND THE ATTEMPTS I HAVE MADE
IN MY LECTURES TO FOLLOW IN
HIS GREAT WORK

A. W. W.

PREFACE

The large number of works on Health that have been published during the last decade are an indication of the growth of a desire among all classes to acquire some knowledge of the Laws of Life, and the existence of these works makes it necessary for the author of yet another book to preface his addition by an explanation. During the past six winters I have been engaged by the West Sussex County Council to deliver lectures at rural and urban districts on the Causes and Prevention of Disease. The lectures have been largely attended, and followed by discussions. Requests for lectures on subjects of special interest in certain districts have frequently been made and acceded to. This has led me to include in my lectures subjects not treated upon in many of the smaller books. Some of these are not of general interest, but others I have found to be of wide and general importance.

The request, frequently repeated, that I would publish my lectures, led the Council to print them as short notes in book form. The books were given to those who attended the lectures regularly. The publication of the little volume only increased the applications for a larger one from many organising secretaries and others engaged in teaching, and on these accounts I have written the following manual. I have included in it the matter of my more important lectures, omitting physiological details, and some subjects which, though important from local reasons, in certain centres are not of much general interest. In order to keep down the size and price of the book the matter has been reduced to little more than notes and tables in places where they could be introduced without sacrificing clearness.

I trust that in its present form it may be found of service to technical instruction and other similar classes.

Arnold Winkelried Williams.

October 1898.

CONTENTS

DOMESTIC HYGIENE

CHAPTER I

CHEMICAL ACTION

The universe, looked at from a materialistic point of view, consists of a number of substances separate and distinct from each other. These substances are endowed with certain powers to act upon one another—*i.e.* to combine, to attract, to repel—and, as a result, visible movement, sound, heat, light, electricity, and other effects are produced. In fact, all that we hear, see, smell, taste, and feel in the universe about us depends upon these powers and properties inherent in the various material substances.

Chemical attraction or affinity is one of the powers possessed by material bodies. Some have a great liking for each other,—they tend to rush together, and two or more separate and distinct bodies may unite and form another substance, entirely different in appearance and properties from those which have united to form it, and yet containing in itself those identical bodies.

Crystalline phosphorus is an element having a great liking for oxygen gas. If phosphorus is slightly heated it combines vigorously with the oxygen in the atmosphere—in other words, it burns brilliantly, and dense fumes of phosphoric acid are produced by this combination. Uncombined crystalline phosphorus is so deadly a poison, that a fraction of a grain may cause death; but, combined with oxygen, in the form of phosphoric acid, it is an important constituent of our bodies, and of plants, and it is one of the necessities of higher organic life.

Oxidation is the chemical action generally used to produce heat. The fire burning in the grate, and the lamp burning on the table, are examples of the oxidation of coal and paraffin oil. The life burning in each of us would cease in

its present form if the processes of oxidation going on in our bodies were stopped. Even such unlikely combustibles as cast-iron are oxidisable. The formation of rust is an oxidation of iron. With high temperature and plenty of oxygen, cast-iron firstly melts, and then burns brilliantly, with a shower of tailed, zig-zag shooting sparks. Oxidation may thus go on gently, as in the case of rusting iron, and in the life-giving processes of our bodies, or it may be furious and brilliant, as in the case of the blazing phosphorus and cast-iron.

The above are very simple examples of chemical transformations; but all of us are familiar with far more wonderful ones. The living body is a chemical machine. In it all sorts of chemical processes are going on. The ox quietly chewing in the meadows is a chemist hard at work. The grass he has eaten, the water he has drunk, and the air he has breathed are his chemicals, and he works wonders with them. He makes them combine, then breaks them up, and then combines them again, and the final result of all, slightly modified by the interference of man, will be roast beef.

The living body may be considered as a machine for directing and utilising the energy of chemical action. When an arm or any part of the body is moved, or when the brain is worked in the act of thought, chemical action has occurred therein. Part of the body has been used up, and may be considered as dead. The new products, the waste dead matters resulting from such vital processes, are useless to the body, and more or less poisonous, and so are removed from the healthy frame by the lungs, kidneys, skin, and alimentary canal. Fresh supplies are evidently necessary to repair this so-called waste. Food is taken in three forms—solid, liquid, and gaseous. The solid and liquid food is taken by the mouth, and passed through the alimentary canal, in which it is digested, and the digestible part passed through the walls of the canal directly or indirectly into the blood, the useless and indigestible part, together with some waste products of vitality, are passed out of the alimentary canal at the anus. Gaseous food consists of oxygen gas. It is breathed into the lungs with the air. Oxygen in the lungs passes from the air into the blood, and certain waste products are passed out of the blood into the air that is expired.

The blood is circulated throughout the body by the heart and other muscles. All tissues requiring nutriment take what they want from the blood, which, after making its tour through them, returns to the heart. Glands are chemical works producing various reagents required by the body; heat is developed in them. The muscles are stores of chemical matter, the oxidation of which results in the movement of the body and heat. The brain and spinal cord are similar stores, and the energy thereof is used to regulate and control all other activity of the body, and to produce the phenomena of thought, will, etc. The bones and ligaments support the soft tissues, protect vital organs, and afford rigid material as points from which muscles can act.

CHAPTER II

CAUSES OF DISEASE

A BRIEF consideration of some of the chief causes of disease, as enumerated below, will show how nearly all are preventable:—

CHIEF CAUSES OF DISEASE.

- (Hereditary Causes. / Injudicious Marriages.)
- Weather and Climate.
- Intemperance
  - Alcohol.
  - Food.
  - Tobacco.
- Mental Overwork and Worry.
- Indolence.
- Bodily Overwork.
- Immorality.
- Irregularity
  - Work and Recreation.
  - Sleep.
  - Meals.
- Uncleanliness.
- Bad Clothing.
- Improper Food.
- Impure Water.
- Impure Air.
- Ignorant use of Medicines.
- Germs of Disease.

Hereditary Causes.—The term "hereditary causes of disease" is applied to causes innate in man, which are handed down

from parent to child. In this case the natural question asked is: An unfortunate individual is born with the germs of disease, or a peculiar tendency to disease, in him—how can he overcome this? We cannot prevent the past, but we can prevent its repetition in the future. The seeds of hereditary disease were generally sown by a gross and persistent neglect of Nature's laws by our forefathers. Gout, which is perhaps the most distinctly hereditary of all diseases, is a good example.

Gout originated in gross habits of over-eating and over-drinking, especially when these were combined with insufficient outdoor exercise. Over-feeding with meats, and over-drinking with strong ales and rich wines, have far more to do with the production of gout than over-feeding with vegetable food and the over-drinking of distilled spirits. Strong spirits taken in excess kill comparatively quickly, and are far less likely to sow the insidious and slowly-growing seeds of hereditary gout, which will flourish better in subsequent generations than in the generation of the original offenders, especially if the members of these following generations themselves offend in a similar way.

A great deal can be done by those inheriting the gouty constitution to prevent their own personal troubles. They must be most careful in their diet. Plenty of fruit and vegetables, lemon-juice, etc., should be taken, while excess of meat and alcohol are avoided. Proper warm and frequently changed clothing must be worn, and outdoor exercise freely taken. They should not follow any occupation in which a risk of lead-poisoning exists.

As with gout, so with many other hereditary diseases, such as Consumption, Nervous Diseases, and Cancer, a great deal, in the way of prevention, can be done.

The question of prevention of hereditary disease leads us to the serious question as to whether sufferers from such disease ought to marry. In the case of a consumptive patient, the question can, without hesitation, be answered by an absolute NO. In the case of nervous constitutions, the marriage of two nervous individuals should be avoided; in such cases the probabilities are strongly against the likelihood of their having healthy children. So it is found the marriage of near relations, as first cousins, both inheriting similar dispositions in their systems, frequently leads to disaster to

the coming generation, and if the tendency of the family is towards nervous disease, insanity not unfrequently results in the children of parents nearly related. Gouty people should also, when possible, try to avoid intermarriages.

Bad Weather and unsuitable Climates are fertile causes of disease. We cannot alter the weather very much, although we can modify slightly the climate of a district; but a good deal can be done to overcome the ill results by proper clothing of the body and proper construction of habitations, and by paying attention to the improvement of the condition of the soil.

The ills of intemperance in food, alcohol, tobacco, etc., are manifestly preventable.

Mental overwork and worry are very common causes of disease, and under our social system as it now exists, they are extremely difficult to prevent. There would be less disease from this cause if it were thoroughly understood that overwork merely means loss of time and loss of work. If we overwork ourselves to-day, we shall pay for it on the morrow, and the time lost by the compulsory stoppage of work caused by illness is far more than the little gained by the hours of overwork. This, however, is not the only loss from overwork —the enjoyment of all the pleasures of life, the healthy enjoyment of our work is wanting, and the refreshing recreation of mind and body, that should be obtained during the intervals between the hours of serious work, is missed. Thus actual loss, both in the quantity and quality of work done, and loss of enjoyment and happiness, are the natural and inevitable results of overwork. Cheques recklessly drawn on futurity have to be met sooner or later, and the time of payment generally comes at some period when our treasury of health is nearly depleted. Especial care must be taken to avoid overstrain by those in whose family nervous disease exists. Tendency to nervous diseases is hereditary. These diseases are of very varying character; they may be manifested, as in exophthalmic goitre, by a swelling in the throat, a protrusion of the eyeballs, and various uncomfortable and alarming symptoms in the heart's action; or, in other cases, nervous disease is exhibited by diabetes, various kinds of paralysis, or by forms of insanity.

Any such family history should make a man doubly careful

about overwork and worry, and should lead a father to persuade his son to take his walk through life along some line that is likely to be fraught with as little worry, excitement, and anxiety as possible.

The ill results of *bodily overwork* are less common than mental overwork: they are similarly preventable.

Indolence.—Disuse will often locate or start disease. It is an important rule in life that we should regularly exercise all parts of the body. Our bodies are so constituted that parts not used gradually waste away and eventually disappear or leave a rudiment behind absolutely useless for its intended work, and only in the way, while, being unhealthy, it is likely to become the site of disease that may spread and destroy life.

Immorality is a great cause of disease, one of the greatest existing, but, happily for mankind, it is a declining cause.

Irregularity.—We ought to be regular in all things; we should work and play, feed and sleep, at regular hours, if we wish to work, play, digest, and sleep well. The body gets accustomed to perform certain acts at certain times, and then it does those acts better and with greater enjoyment to the individual as a whole. Students working for examinations would do well if they were to read up the subjects at the time of day when the examinations in those subjects will take place. They would then go in with their minds in condition, fit and ready for the work.

Uncleanliness and Bad Clothing, Impure Food, Water, and Air will be considered later on. They are all manifestly preventable.

Ignorant use of Medicines.—Physic is responsible for much, both good and evil. Drugs in health, if they are drugs that act at all on the bodily functions, must do harm. In disease, drugs at the wrong time, or the wrong kinds of drugs, are not only capable of doing fresh injury to the body, but they may also aggravate disease. Many people are very fond of physic, they revel in swallowing it, but they only reach their highest pinnacle of delight when they recommend and can persuade others to swallow it. They deceive themselves with words, they talk glibly of inflammation and congestion, of cathartics and carminatives. They talk, and, unfortunately, they act also, on the strength of words they know, but the meaning of which

is to them a closed book, and they too often do injury to themselves and the unfortunate ones who act on their advice. The body is a most complicated machine, and the processes of disease make its working inexpressibly more complicated. Nature has ways of curing very many of the bodily ills, and the wise physician uses his medicines so as to assist Nature when he knows how Nature works ; in but few cases does it answer to adopt other methods.

The best advice to medical amateurs with self-control incapable of restraining them from physicking themselves and their equally foolish acquaintances, is that they should use only homeopathic medicines of the most extreme dilution, and these in strictly infinitesimal doses.

An example of the harm done by reckless physicking can often be studied in the case of cough mixtures. A cough is Nature's way of removing irritating material from the lungs.

In bronchitis a large amount of mucus is secreted, and this must be expectorated, together with the irritant that caused its production. If the cough is stopped too early, as it often is by opium cough mixtures, this accumulation of mucus, etc., has to be got rid of by the slower process of absorption. A mass of bad matter, with unhealthy tissue around it, is thus left for a time in the lungs. If an individual in this condition should happen to meet and inhale stray consumptive germs—and there are many such floating about—they may alight on this matter, and find in it a comfortable feeding and resting-place. They multiply therein, and pour out on the tissues around irritating and poisonous secretions, and then the newly-formed germs invade and destroy the weakened tissues, setting up the dread disease we know as consumption. The healthy membrane lining of the bronchial tubes possesses a most wonderful mechanism for getting rid of and destroying any germs that may find their way into the air tubes. If the attack of bronchitis had been treated by the right drugs at the right time the secretion would have been stimulated until it and the irritant had been got rid of and the cough then stopped, and in this case probably such a catastrophe would not have happened. An awful and wicked wrong is often done to little infants by administering to them sedatives in the form of soothing syrups. The evil done by these things, given recklessly to infants, not only causes occasional deaths, directly from the action of the

drug, but invariably does serious harm to the child's constitution, from which it will suffer more or less throughout the whole of its existence.

Other evil drug habits are described in Chapter VI.

Germs of Disease.—A large number, probably the majority, of diseases, are caused by living germs growing in the body. Most of these germs belong to the vegetable class known as bacteria. Bacteria are very minute organisms; so tiny are they that in some cases it would take as many as 250,000 of them in a row to make a line one inch long. They multiply by a simple process of division, one divides into two, and the two again divide, and so on. Under favourable conditions, the rate of multiplication is enormous. Thus, in the case of one of the forms of abscess-causing germs if implanted in suitable beef broth, each of these originally planted in the medium will in twenty-four hours be replaced by a host 80,000 strong. In shape they vary, despite their name bacteria. Some are rounded and called micrococci, others are more rod-like, and called bacilli; others are spirally twisted or broken up into comma-shaped bodies, these are the spirilla (fig. 1). Another class of disease-causing germs are forms of the mould fungi.

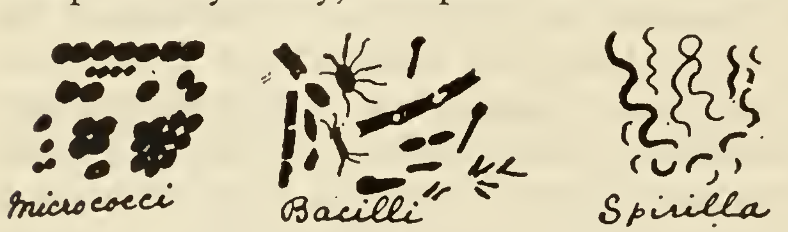

Fig. 1.

Germs of disease belonging to the animal kingdom are common; thus, ague is due to a minute microscopic jelly animal. Various forms of mature and immature worms cause disease. Certain insects, spiders, and beetles, might also be included among the disease-causing germs. Bacteria and other tiny disease germs are spread about by dust in the air, by water, by solid foods, through the ground, and by drainage. The body is the soil in which the germ seeds grow. The soil may be rendered unsuitable, and so the development of disease prevented. Perfectly healthy tissues can resist the growth of most bacterial diseases, therefore, in order to make the soil barren for disease growth, all causes such as those above enumerated, that depress health and vitality, must be avoided. In some diseases, however, even healthy tissues cannot resist the germ attack—*e.g.* anthrax and small-pox; so

other means, such as vaccination, have to be adopted to make the soil barren, and to attack the germ foe with poisons and fire. In most disease an excessively great host of germs may break through the strongest barrier of health, but with ordinary care in sanitary matters so great a host need never exist.

THINGS AND CONDITIONS ADVERSE TO GERM LIFE AND ACTION

DEFINITION OF TERMS

Disinfectant.—An application possessing power of absolutely destroying germ life.

Antiseptic.—An application capable of preventing vital action of germs, either of multiplication, or of producing chemical and other effects, without actually destroying their life.

Deodorant.—An application capable of overcoming the evil-smelling products of putrefactive germs, either by destroying the smell or hiding it by another, but which may not destroy the germs, or even inhibit their action.

APPLICATIONS USED

Bright white light, air, and moisture.—Capable of destroying most bacterial germs. Peroxide of hydrogen formed, and this substance is a powerful disinfectant. Germs with spores only destroyed after very prolonged exposure. Yellow light has little or no action.

Dryness.—Germs without spores are destroyed by perfect drying—*e.g.* most pus organisms : typhoid, cholera, pneumonia, chicken cholera, etc.

Temperature.—Extreme cold acts on the majority of germs as an antiseptic. Great heat acts as a disinfectant. Moist heat is more powerful than dry heat. Exposure to dry heat of 220 deg. F. for one hour destroys germs of practically all infectious diseases; dry heat, however, penetrates such things as bedding with great difficulty and very slowly, and so in practical disinfection of such goods is not of great value. Exposure to boiling water or steam of 212 deg. F. is a complete disinfecting process. Steam penetrates more easily in

bedding than dry heat, and still more easily when under pressure or in currents. There are many excellent forms of apparatus for using current or pressure steam; and as this is the only reliable means of disinfecting bedding and such fabrics that cannot be boiled in water, one or other of these appliances is a sound and necessary investment for sanitary authorities.

Chemical disinfection.—A large number of the many substances used for this purpose are useless, some may be antiseptic, the majority are merely more or less efficient deodorants.

Carbolic Acid is a representative of a large group of disinfectants. Mixed with water in strong solutions or emulsions they still retain a germ-killing action, thus 1 in 20 carbolic is a disinfecting and deodorising solution, weaker solutions act only as antiseptics to the more resisting germs. Among carbolic group are Izal, Creolin, Solutal, Zotal, and a variety of others, some of which are more powerful than carbolic acid.

Another group is represented by turpentine—a disinfectant in strong emulsion, and antiseptic in weak, and a good deodoriser. Turpentine varies in amount of oxygen it contains, and varies in its power. Sanitas, Eucalyptus oil, and Camphor are examples of this group.

Chlorine, Iodine, Bromine, Ozone, and Sulphurous Acid are representatives of a large group of disinfecting gases. They require to be fairly concentrated. Sulphurous acid is produced by burning sulphur in air. Its action is not rapid, but, if concentrated, fairly efficient. Chlorine, and various chlorine-like bodies are contained in the substance known as chloride of lime, or, more correctly, chlorinated lime. These are given out freely on adding an acid. Iodine and bromine are too expensive for general external disinfection.

Freshly burnt lime and water destroy germs.

Permanganate of potash in solution (known as Condy's fluid) acts better in presence of an acid. To disinfect fluids containing a lot of organic matter, it is by no means an efficient material, its power is rapidly destroyed as it touches organic matter.

A series of bodies produced by action of organisms in living or dead matter, if concentrated, possess disinfecting or anti-

septic powers. Alcohol is an example, it is a disinfectant only when concentrated. An altered alcohol, known as Formic Aldehyde, is an extremely powerful disinfectant, and is now being largely used to disinfect fever rooms, etc. Formalin is a strong solution of Formic Aldehyde. Strong Acetic Acid is another example of a germ-formed disinfectant, or antiseptic when diluted as vinegar.

Corrosive Sublimate is a powerful disinfectant. A solution of 1 in 1000 destroys all known forms of bacteria. Other mineral salts possess, but in a less degree, disinfecting power; chloride of zinc is an example (Burnett's disinfecting fluid). Sulphate of iron and copper act as antiseptics and deodorisers. Sulphate of iron acts very well in privy middens.

Boric Acid is a good antiseptic.

Chemical disinfectants and antiseptics cannot be relied on to purify a large mass of organic matter, or to disinfect a large drain or cesspit. The dangers of bad smells from such causes now dwelling are not overcome by putting a little solution or powder down the drain,—the origin of smell must be searched for, and the cause removed. If so-called disinfectants are used, powders should not be put down water-closets and drains; solutions only should be used. Powders are valuable for manure heaps, cesspits, etc. For use of disinfectants in prevention of infectious diseases see Chapter XVI.

CHAPTER III

DIGESTION

The solid and liquid food taken by the mouth are digested in a long tube going right through the body. Digestion is a chemical process, whereby certain constituents of the solid food are altered in order that they may dissolve in water, and be able to pass out of the digestive or alimentary tube into the blood.

The changes in the food are brought about by the agency of

juices poured out on the food as it passes through the alimentary canal. These juices are the saliva of the mouth, the gastric juice of the stomach, the bile from the liver, the pancreatic juice from the sweetbread, and the intestinal juice of the bowels.

The processes of digestion do not always go on smoothly. They are frequently deranged, and, as a result, dyspepsia or indigestion with all its troubles, arises, and life is made a misery to the sufferer, his friends, and his relations. The chief causes of dyspepsia are :

(1) Bad teeth and eating too fast (pp. 12, 13).
(2) Irregular feeding (p. 13.)
(3) Over or under feeding (Chap. IV.).
(4) Bad food, water, or cookery.
(5) Indulgence in stimulants and condiments (pp. 30, 33).
(6) Excessive mental work and anxiety.
(7) Exhaustion before meals (p. 13).
(8) Heavy bodily or mental work directly after meals (p. 14).
(9) Sleeping directly after meals (p. 14).
(10) Want of exercise (p. 14).
(11) Unpalatable and monotonous food (p. 14).
(12) Breathing bad air (Chap. X.).
(13) Many general diseases.
(14) Defective action of bowels (a cause and effect).

Bad Teeth and Eating too fast.—In order that the saliva can do its work, the food must not only be chewed, but must be kept for a while in the mouth. When the saliva is swallowed and reaches the stomach, its power of digestion is soon destroyed. The habit of hurrying over meals and bolting the food too rapidly is thus responsible for a great deal of indigestion. Farinaceous food especially requires to be acted on by the saliva, and so porridge, bread and milk, and rice, tapioca puddings, etc., although not requiring chewing to enable them to be swallowed, must remain for a sufficient time in the mouth. Flatulence of a distressing character is a common result of hastily bolting such food.

Bad teeth are often caused by neglect of brushing, and allowing particles of food to remain sticking about and between them. The teeth ought to be thoroughly brushed at

night with a little soap and water or powdered charcoal, or chalk, or a little spirits of sal-volatile and water. Brushing with powdered pumice stone or cuttle-fish bone is injurious. The use of strong acids, such as are sometimes used by quacks who undertake tooth scaling, is highly injurious. Children ought not to be fed too exclusively on slop food. They should always be allowed something requiring chewing, in order that their teeth may be regularly used. Decayed teeth must be stopped as soon as possible. Overcrowding of the jaw, in consequence of the first teeth remaining when the second are being cut, favours decay in the new teeth. Children who have had fits, or bad inflammatory diseases of the mouth, during infancy must be taught to be most careful about their teeth. Eating biscuits, sweets, etc., between meals is very bad for the teeth, as well as for the digestion generally.

Irregular Feeding.—Meals must be taken at absolutely regular times, and no solid food, or any liquid other than water, should be taken between meals by a healthy individual. Three meals should be taken daily according to one of the following plans :—

Divide daily food into nine portions and take either—

3 portions for breakfast,
4 portions for dinner (mid-day),
2 portions for supper ;

Or,

3 portions for breakfast,
2 portions for lunch,
4 portions for late dinner.

Exhaustion before Meals.—We ought not to thoroughly exhaust ourselves. When the system is completely tired out, the power of digesting food is wanting, and, consequently, the repair of the exhausted system becomes difficult, and if a strain is put upon the digestive functions a serious breakdown may result. When injurious conditions of excessive fatigue are encountered, it is a mistake to take a heavy meal, but a small quantity of easily-digested food should be taken beforehand, such, for example, as an egg beaten up in a little warm milk and water. Such a condition is an example of the extremely rare cases where alcohol is of great service as a food material. A little may be taken before the meal, but the

amount must be small and well diluted. At the most, a tablespoonful of good spirits in half-a-tumbler of warm water, or a small glass of sherry in water. This is not safe for every one. An exhausted system craves for stimulants, and unless the individual possesses a fairly large amount of self-control, the above-mentioned limit may be dangerously exceeded (p. 31).

Bodily and Mental Work or Sleep directly after Meals.—Great occupation of mind or muscles delays the process of digestion; on this account heavy work should be avoided directly after food. In like manner sleep must be avoided; for during sleep the movements of the muscular coat of the stomach essential to proper digestion cease. It is therefore necessary to allow at least one hour and a half to pass between the last meal and bedtime; moreover, the pernicious habit of leaving the table and immediately falling to sleep in the arm-chair must not be acquired.

Want of Outdoor Exercise.—Want of muscular exercise sets up indolent states of the liver and other parts of the digestive apparatus; moreover, the inefficient supplies of fresh air lead to imperfect utilisation of the food taken, and dyspeptic and gouty states are apt to result. Adults should try to obtain an equivalent in outdoor exercise of from seven to nine miles' walk daily (p. 149).

Unpalatable and Monotonous Feeding.—Enjoyment of food stimulates the secretion of digestive juices. On this account we should introduce variety into our food from day to day, and variety also in the methods of cookery.

Daily Evacuation of the Bowels is absolutely necessary for the health of both body and mind.

Regular exercise, regular feeding, and regular habits in every way promote regular action of the bowels. In cases of difficulty, great benefit is often derived by taking a little fruit at night, and plenty of brown bread, oatmeal, and green vegetables as constituents of the daily food.

The bowels act better and more naturally shortly after breakfast.

Bad Food.—Bad combinations (pp. 15, 20) of food, and bad cookery result in dyspepsia and other ills.

Excess of pastry and rich meats, like pork, goose, duck, etc., often give rise to irritative forms of dyspepsia.

Various conditions of disease and states of decomposition of animal and vegetable substances make food injurious.

The poisonous substances developed in decomposed meats vary considerably in different kinds of meat, thus: high game is generally wholesome; high mutton, especially of small mountain sheep, is not very injurious; high beef is always bad; high pork is extremely injurious; and high fish, high shell-fish, crabs, and high sausages, are always poisonous, and often deadly.

CHAPTER IV

FOODS

The food stuffs used by man are legion. All the valuable foods contain one or more of the following:—

(1) Nitrogenous compounds $\begin{cases}\text{Proteids.}\\ \text{Albuminoids.}\end{cases}$ (2) Fats.

(3) Carbohydrates $\begin{cases}\text{Sugars.}\\ \text{Starches.}\\ \text{Gums.}\\ \text{Cellulose.}\end{cases}$ (4) Salts. (5) Water.

A properly arranged dietary must contain a certain percentage of each of the above chemical principles.

Nitrogenous food compounds are often termed the flesh formers. There functions are: 1st, To build the tissue framework, and to repair the wear and tear of active body machinery. 2nd, To regulate the oxidation or burning of the fuel supplying the body with energy, both of heat and activity. 3rd, To be themselves burnt up and used as fuel.

If nitrogenous foods are completely removed from the diet, even with unlimited supply of other food principles, wasting away of the tissues, followed by death, is the inevitable sequence. If supplied but in deficient quantity, general enfeeblement, erratic combustion of the tissues, and want of control results. If they are supplied in excess, dyspepsia,

gout, headaches, feverish symptoms, and general irritability of temper and body follow in due course, especially in those leading sedentary lives. A man doing a hard day's work out-of-doors rarely over-eats.

Examples of Rich Nitrogenous Foods.—Meat, bones, cheese, peas and beans, eggs, milk.

Fats are chiefly valuable as combustion foods. They are used up in the body to develop heat, visible movements, and other forms of vital energy.

Fatty tissues in the body are valuable as means of protection, and as possible stores of food in occasional times of privation; they are built up from proteids, fats, and carbohydrates.

Carbohydrates—e.g. sugar, starches, gums, and cellulose—act in a very similar way to fats. To a certain extent, fats and carbohydrates are interchangeable in dietaries. In cold climates the fats should be increased, in warm the carbohydrates. If, however, the fats are entirely replaced by carbohydrates in a dietary for a long time dyspepsia and malnutrition arises; this is partially on account of the large bulk of food that has to be taken. If carbohydrates are entirely replaced by fats, digestion fails, sickness and diarrhœa may occur. Excess of fats and carbohydrates causes dyspepsia, and in some cases, especially in excess of carbohydrates, obesity.

Salts necessary for food are many. (1) Common salt is an imperative necessity for life and health.* About $\frac{1}{4}$ oz. is required daily in addition to that naturally present in the other foods: this includes the salt used in cookery.

Phosphates, especially phosphate of lime, are important food salts, the importance of plenty of such salts is greater during the period of growth.

Iron and other salts are also necessary, although the amounts required are less. Salts of vegetable acids are imperatively necessary. (See p. 25).

Water.—$2\frac{1}{2}$ to 4 pints would represent the average amount required. It varies largely with exercise, climate, and the individual, and his state of health.

* Supplies the soda necessary for salivary digestion. Supplies the hydrochloric acid of gastric juice. Keeps solid and liquid parts of body properly mixed.

PERCENTAGE COMPOSITION OF FOOD STUFFS

	Water.	Nitrogenous.	Fats.	Carbohydrates.	Salts.
Best Beef Steak	74·4	20·5	3·5	...	1·6
Soldiers' Meat	75·0	15·0	8·4	...	1·6
Very Fat Meat	63·0	14·0	19·0	...	3·7
Cooked Meat, with Dripping	54·0	27·6	15·5	...	2·9
Corned Beef (Chicago)	52·2	23·3	14·0	...	4·0
Fat Pork	39·0	9·8	48·9	...	2·3
Dried Bacon	15·0	8·8	73·3	...	2·9
Smoked Ham	27·8	24·0	36·5	...	10·1
Poultry	74·0	21·0	3·8	...	1·2
Tripe	68·0	13·2	16·4	...	2·4
Liver	71·4	19·7	5·6	...	3·3
Kidney	76·5	16·5	5·5	...	1·5
Blood	77·9	21·2	0·2	...	0·7
Suet	10·62	1·0	88·38	...	...
Salmon	64·29	21·60	12·72	...	1.39
Herring	74·64	14·65	9·03	...	1·78
Mackerel	71·20	19·36	8·08	...	1·36
Cod	82·20	16·23	0·33	...	1·36
Dried Cod (unsalted)	16·16	81·54	0·74	...	1·56
Do. (salted)	13·20	73·72	3·37	...	10·0
Egg	74·0	14·0	10·5	...	1·5
New Milk	86·0	4·0	3·7	4·8	0·7
Skim Milk	88·0	4·0	1·8	5·4	0·8
Butter Milk	88·0	4·1	0·7	6·4	0·8
Butter	14·0	0·0	84·0	0·0	2·0
Wheat Flour	15·0	11·0	2·0	71·2	0·8
Oatmeal	15·0	12·0	6·0	63·0	3·0
Rice	10·0	5·0	0·8	83·2	0·5
Maize Meal	13·5	10.0	6·5	68·5	1·5
Macaroni	13·5	9·0	0·3	76·8	0·8
Dry Peas	15·0	22·0	2.0	53·0	2·4
Potatoes	74·0	2·0	0·16	21·0	1·0
Cabbage	91·0	1·8	0·5	5·8	0·7
Bread (white)	40·0	8·0	1·5	49·2	1·3
Cheddar Cheese	36·0	28·4	31·1	...	4·5
Skim Cheese	44·0	44·8	6·3	...	4·9
Beetroot	87·0	1·5	...	9·0	1·0
Carrots, Parsnips, Salsify	88·0	1·0	...	8·0	1·0
Turnips	91·0	1·0	...	6·0	1·0

DAILY DIET IN TEMPERATE CLIMATES

	Subsistence.	Ordinary work.	Laborious work.
Nitrogenous	2·0 oz.	4·5 oz.	6·5 oz.
Fats	0·5 oz.	3·0 to 3·5 oz.	4·0 oz.
Carbohydrates	12·0 oz.	15·0 to 14·0 oz.	17·0 oz.
Salts	5·5 oz.	1·0 oz.	1·3 oz.
Total water-free food	15·0 oz.	23·0 oz.	28·8 oz.

GRAINS PER LB. OF CARBON AND NITROGEN

	C	N		C	N
Split Peas	2698	248	Skimmed Milk	438	43
Indian Meal	3016	120	New Milk	599	44
Barley Meal	2563	68	Skim Cheese	1947	483
Seconds Flour	2693	86	Cheddar Cheese	3344	306
Rye Meal	2700	116	Bullocks' Liver	934	204
Oatmeal	2831	136	Mutton	1900	189
Bakers' Bread	1975	88	Beef	1854	184
Pearl Barley	2660	91	Fat Pork	4113	106
Rice	2732	68	Dry Bacon	5987	95
Potatoes	769	22	White Fish	871	195
Turnips	263	13	Red Herring	1435	217
Green Vegetables	420	14	Dripping	5456	...
Carrots	508	14	Suet	4710	...
Parsnips	554	12	Lard	4819	...
Sugar	2955	...	Salt Butter	4585	...
Treacle	2395	...	Fresh Butter	6446	...
Buttermilk	387	44	Cocoa	3934	140
Whey	154	13	Beer and Porter	274	1

Full diet for ordinary work would be about 4790 of C. and 315 gr. N.

The above data enable one to calculate the daily requirements of man under varying conditions of work and rest. The *subsistence diet* is suitable for a person in recumbent position, only using absolutely necessary movements for maintenance of life.

Ordinary work—e.g. the work done by a man weighing 160 lbs. in a walk of 16 miles along a level road at three

miles an hour, or the work done by such a man in lifting 300 tons weight one foot high; the temperature in both cases averaging 50 degrees F.

Laborious work—work done in lifting 500 tons weight one foot high.

The simplest calculation can be made by aid of an analytical table giving grains per lb. of carbon and nitrogen: its method is self-evident. Such calculations are no guide to the amounts of salts, or to the relative amounts of carbohydrates and fats. More accurate calculations can be made by aid of table giving percentage composition of the food material. The readiest process to calculate a daily diet is by simultaneous simple equations, thus:

If oatmeal, milk, and butter be required,

$$\text{Daily requirements for ordinary work} = \begin{cases} \text{Nitrogenous} & 4{\cdot}5 \\ \text{Fats} & 3{\cdot}5 \\ \text{Carbohydrates} & 14{\cdot}0 \end{cases}$$

Let x = amount of oatmeal required.
Let y = " milk "
Let z = " butter "

Construct first equation to equal amount of nitrogenous food required:

Oatmeal contains	12·0	per cent.	of nitrogenous.
Milk "	4·0	"	"
Butter "	0·0	"	"

So first equation may be stated—

$$(1)\quad \frac{12x+4y}{100}=4{\cdot}5$$

Construct second equation to equal amount of fats required:

Oatmeal contains	6·0	per cent.	of fat.
Milk "	3·7	"	"
Butter "	84·0	"	"

So second equation may be stated—

$$(2)\quad \frac{6x+3{\cdot}7y+84z}{100}=3{\cdot}5$$

Construct third equation to equal carbohydrate wanted :

Oatmeal	contains	60·0	per cent.	of carbohydrates.
Milk	"	4·8	"	"
Butter	"	0·0	"	"

So third equation may be stated—

$$(3) \quad \frac{60x + 4 \cdot 8y}{100} = 14 \cdot 0.$$

These equations can then be solved by algebraical methods.

The following are examples of daily dietaries :—

	Subsistence.	Ordinary work.	Laborious work.
Cooked Meat . .	$\frac{1}{4}$ oz.	8 oz.	$16\frac{1}{2}$ oz.
Bread . . .	$24\frac{1}{2}$ oz.	29 oz.	35 oz.
Butter (salt) . .	$\frac{1}{2}$ oz.	2 oz.	$\frac{3}{4}$ oz.

OTHER DAILY DIETS FOR ORDINARY WORK

(*a*) White Fish, 17 oz.	Potatoes, 68 oz.	Salt Butter, $3\frac{1}{4}$ oz.
(*b*) White Fish, 14 oz.	Bread, $29\frac{1}{2}$ oz.	Salt Butter, 3 oz.
(*c*) Milk, 55 oz.	Oatmeal, $19\frac{1}{4}$ oz.	Salt Butter, $\frac{1}{4}$ oz.
(*d*) Dry Peas, $16\frac{1}{3}$ oz.	Potatoes, $25\frac{1}{2}$ oz.	Bacon, $4\frac{1}{3}$ oz.
(*e*) Cheese, .6 oz.	Salt Butter, $2\frac{1}{2}$ oz.	Bread, $20\frac{1}{2}$ oz.
Apples, 50 oz.		
(*f*) Potatoes, 50 oz.	Buttermilk, 50 oz.	Bacon, 4 oz.
Liver, 5 oz.	Cabbage, 8 oz.	Salt, $\frac{1}{4}$ oz.
(*g*) Skim Milk, 58 oz.	Bread, 22 oz.	Fat Pork, $2\frac{1}{3}$ oz.
Salt, $\frac{1}{4}$ oz.		
(*h*) Eggs, 6 oz.	Bread, 30 oz.	Smoked Ham, $5\frac{1}{2}$ oz.

Climatic conditions also modify the amount and character of food required. One of the objects of food is to keep up the body temperature; and, consequently, man requires more food in cold climates. British subjects going into the tropics often make the grave mistake of trying to eat as much as they did in their cold fatherland. Their appetite naturally is less, and they try to stimulate it with hot curries and spices, and the result is disease, and often death.

CHAPTER V

FOODS (*continued*)—ANIMAL FOODS

Flesh Foods.—Rich in nitrogenous food and fats. Contain also a fairly large amount of salts. These are largely phosphates of potash. Another important group are known as extractives; these act as stimulants—chemically, they are altered proteids. Beef tea owes its stimulating properties to the extractives it contains. Carbohydrates are practically absent in flesh foods.

Appearance of Sound Meat.—Colour is fairly uniform. Beef should be slightly marbled with streaks of fat, and bright in colour. All flesh should be firm and elastic to the touch, and while juicy should not be watery (healthy frozen meat may be wet after thawing). There should not be jelly or mattery liquid between muscles or in fat. Suet should be hard, yellowish in colour, and not blood-stained (except a diffuse pinkness in the case of frozen meat). A clean knife plunged into the centre of a joint should be quite free from unpleasant smell when withdrawn. The inspection of viscera and surfaces for diseased conditions can only be studied by practical experience and with knowledge of morbid anatomy.

The carcases of animals suffering from any of the following diseases should be destroyed:—

Tuberculosis, foot and mouth disease, diarrhœa, cattle plague, pleuro-pneumonia, sheep pox, acute rheumatism, pig typhoid, scarlet fever, erysipelas, anthrax, peritonitis, puerperal fever, measly condition, trichinosis, and also the carcases of animals that have been taking strong drugs, such as antimony and arsenic. Sheep slaughtered when infected with the rot (fluke disease) should have the liver and all internal parts destroyed, and the flesh ought to be well cooked when eaten; if the disease is in an advanced stage, the entire carcase must be destroyed.

Beef.—Richest meat in nitrogenous matter. Very strong in extractives. Well suited for hard work.

Mutton.—Fibres as a rule more easily broken up than in beef, and so easier for digestion. In some forms of dyspepsia the want of flavour is an advantage, in other forms a great disadvantage, it does not stimulate the digestive juices so freely.

Veal is of very poor value when under one month old. Frequent bleeding to get very white meat diminishes its nutritive value. Fibres easily elude mastication, and so cause difficulty in digestion.

Lamb is not an economic meat. There is more water and less proteid matter than in mutton. Most people find it easy to digest.

Goat.—Stronger in nitrogenous food than mutton. It is more difficult to digest, and so unsuitable for dyspeptics.

Pork is not a good food for people with a tendency to dyspepsia, with bad teeth, or for those leading an indoor life. The large amount of fat stored up by the *domestic* pig and the hardness of its fibres render it difficult to digest. Pork must be well masticated. It must be very well cooked, as pigs are generally kept under insanitary and filthy condition, are often fed on bad food, and are very liable to many diseases transmissible to man. Tubercle, tape-worm, trichinosis, and other diseases are common (Chap. XVIII.).

Sucking Pig.—Easier of digestion than adult pork.

Poultry, etc.—Domestic Fowl.—Fat mostly stored in and under skin, and in internal parts; it should be avoided by dyspeptics. Flesh almost equal to beef and mutton in nitrogenous matter, but is wanting in extractives; when derived from young birds it is easily digested, and well suited for invalids; in many cases stimulating extractives should be added in form of beef tea, etc. Poultry are rich in phosphatic salts.

Wild Birds.—Flesh more nitrogenous than in chickens. Muscle tougher, unless kept for a time; putrefaction loosens fibres (p. 15).

Goose and *Duck.*—Much fatter food. Fat very unsuitable for weak digestions.

Rabbits.—Young rabbits resemble chickens in value. Old rabbits' flesh very hard to digest. Rabbit pies should always be made with cooked flesh, and be well ventilated; poisoning at times occurs from volatile poisons sealed up in the pie.

Hares harder to digest than rabbits, unless eaten high. They are not so dangerous as rabbits when decomposing.

Fish. — Compared with butcher's meat white fish contain more water, less fat, and less extractives. White fish are much easier to digest than the pink and fatty fish. *White Fish—e.g.* whiting, sole, plaice, turbot, haddock, cod, ling, skate, sprat,

tench, roach, pilchard, mullet, halibut. *Rich and Fatty Fish.*—Salmon, eel, herring, trout. *The Mackerel* belongs to white fish, but is to many people difficult to digest.

Fish as an exclusive diet is not suitable to luxurious races: the digestion and appetite misses the stimulating extractives.

Crustacea—*e.g.* crabs, lobsters, shrimps, and prawns—are apt to cause digestive troubles when eaten freely.

Shell Fish.—Oysters, an extravagant over-rated food. They consist almost entirely of water with a little nitrogenous food matter, and a fair amount of extractives. The contents of the shell are as follows:—

Water, 89·69 %; proteid (albuminous), 4·95 %; fat, 0·37 %; extractives, 2·62%.

If a man relied on oysters to supply his nitrogenous food he would require at least ten dozen daily. Shell fish are often grown in water to which sewage has access, and become poisonous (p. 164).

Brain Tissue.—Large amount of fat renders it rather difficult of digestion in some cases.

Kidneys.—Chemically almost equal to muscle. The substance is difficult to digest, and much escapes digestion; on this account not suitable for invalids. Good cookery imperative. Require fat food—*e.g.* bacon—with them.

Blood.—Highly nutritious (see analysis). Strong flavour. It easily upsets stomach. Extremely rich in important salts. Pigs' blood is especially rich in phosphates. Blood decomposes rapidly, and so requires immediate and prolonged cooking.

Black Puddings (blood, fat, groats, and herbs) are a strong food for those capable of digesting them.

Liver.—Highly nitrogenous and rich in fats. A most nutritious food. Fat difficult to digest. Liable to be infected by various organisms, and so must be cooked well and in small pieces.

Omentum and *mesentery* (eaten in pigs' and lambs' fry).—Rich in fatty food. Must be very well cooked. Liable to contain glands full of tubercle, and so, if not very much cooked, is highly dangerous.

Tripe.—Stomach and intestines. Fairly strong in proteid matters, but weak in stimulating matter. Very easily digested. Must be, as it generally is, well cooked, especially the intestines (chitlings), or liable to spread disease such as tubercle.

Heart.—Chemically equal to other flesh, but harder to digest.

Bones.—Rich in gelatine, an albuminoid substance, which, although a valuable nitrogenous food, requires a little true proteid with it. Bones of young animals are of greater value than bones of old. Dry bones actually contain a larger proportion of nitrogenous food matter than fresh bread or meat (*i.e.* one-third weight). In order to obtain all the bones require pounding and prolonged boiling.

Sweetbreads.—Three glands sold by butcher under this name. Must be well cooked, as one form of sweetbread—*i.e.* thyroid gland from the throat—contains a substance which, unless destroyed by cooking, has a profound action on the nervous system and nutrition.

Milk is the only single food containing all the necessary food principles. For adults, it is somewhat deficient in carbohydrates, and so requires mixing with cereals, etc. (*e.g.* diet *c*, p. 20). Skim milk, excepting fats, is equal in dietetic value to new milk. Butter milk has similar value. Milk may be contaminated with disease, and so is safer cooked (p. 112).

Butter.—A fat food. It is better to give young children other fats, as butter is frequently contaminated with tubercle. Sterilisation of cream by Pasteur's method is the only remedy for this danger.

Cheese.—A valuable rich nitrogenous and fatty food. A little difficulty in digestion lowers its value. Grated cheese, cooked by heating and dissolving it in milk, to which a trace of bicarbonate of potash has been added, is more easily digested. Cheese cooked until it becomes leathery and stringy is hard to digest.

Eggs.—Valuable food. Contain all food principles, excepting carbohydrates. When raw or lightly cooked are easily digested. Eggs should not be hard boiled. Coddled eggs—*i.e.* eggs cooked by plunging them in a jar of boiling water which is removed from the fire—are more easily digested than boiled eggs.

Preserved Food.

Salted Meat.—Great part of salts, extractives, and food proteids pass into brine and are lost. Chemical changes occur in brine and its contents, so that when used over and over again it becomes very poisonous. Salt meat is only two-

thirds the value of fresh meat in nutritive principles, and is much harder to digest. This has always to be considered in reckoning the economy of salt provisions. Well-prepared bacon is an exception to the rule of lessened digestibility. Properly cooked it takes about three hours to digest, whereas fresh roasted pork takes about five hours. If preliminary salting is overdone, or the after-drying process carried too far, the flesh shrinks and hardens, and the bacon becomes very indigestible. Food preserved by chemicals—boric acid, salicylic acid, and some others—is not advisable. Although the case is not fully made out against them, there is little doubt that free use of them would be most injurious.

Tinned Meats, good in condition, and carefully tinned, are better in nutritive value and digestibility than salted meat. Frozen meat is of great value. Some of the juices and salts are apt to be lost in cut joints, especially if small, after thawing. Danger from worm-caused disease (Chap. XVIII.) less in frozen bacterial diseases are not prevented.

CHAPTER VI

VEGETABLE FOODS

Vegetable Foods.—The vegetable kingdom supplies man with most valuable food stuffs. Carbohydrates, almost absent in animal food, are strongly represented in vegetables. Sugars, starches, gums are digestible, and assimilated by man. Cellulose, a vegetable carbohydrate, can only be digested to a very slight extent by man. It, however, serves a valuable end, in so far that it stimulates regular action of the bowels (p. 14). The herbivorous animals have large or long alimentary canals, in which the cellulose is digested and converted into sugar, less by the action of the digestive juices than by the fermentation set up by micro-organisms.

Vegetables also contain a number of salts not represented in the animal kingdom, except in fresh milk. These are known as *anti-scorbutics.* They prevent the development of a dreadful disease—scurvy.

Vegetable foods may be divided into several groups.

Group I.—Cereals and chestnuts consist mainly of carbohydrates; contain moderate amount of proteids; certain important salts (not very rich in anti-scorbutics); small amount of fat.

Wheat, barley, oats, maize, rice, and rye are the most commonly used cereals.

Wheat.—The outer layers of wheat discarded in white flour contain nutritious principles—*i.e.* phosphates, proteids, and a ferment capable of turning starch into sugar (work done by salivary and pancreatic juices). It also contains cellulose and silica (flinty material). The latter act as intestinal stimulants, especially when bran is not finely ground, and in some people hurry on the contents of the intestines so that full time for absorption of nutriment is awanting, and much valuable material is wasted in bowel discharges, and this not only of the bread itself but of other food taken. People whose bowels act freely are generally better nourished, and more economically, on white than on brown bread; people of constipated habit do better on brown bread. Wheat flour contains several nitrogenous compounds and a large amount of starch. When the flour is mixed with water two of these compounds combine and form a sticky substance—gluten. The sticky nature of gluten prevents rapid escape of gases if generated in the paste or forced into it. Bread-making consists of aerating the flour and water so as to raise it, and then baking so as to cook the starch grains and fix the paste in its porous state.

Barley does not form gluten like wheat, so raised bread cannot be made from it. It is rather weaker in nitrogenous matter, richer in fat, than wheat. Very rich in phosphates and iron. Slightly laxative action on bowels.

Oats.—Richer than wheat in nitrogenous matter; richer even than barley in fatty matter. Light bread cannot be made. Slight laxative action on bowels.

Maize.—Slightly weaker in nitrogenous matter than wheat; richer even than oats in fatty matter. Must only be eaten when in good condition.

Rice.—The weakest of ordinary used cereals in nitrogenous and fatty matter. It is little more than a carbohydrate food, and much more suited for diet in hot than in cold or temperate climates.

Certain conditions of disease and decomposition of grain

cause disease. A curious microscopic fungus, known as the ray fungus, is apt to grow in many cereals, and the chewing of such grain and straws by stablemen and others occasionally gives rise to a horrible disease known as actinomycoses. Decomposed maize gives rise to a peculiar fatal disease in countries where it is much eaten. Ergot of rye, also, at times causes fatal epidemics of disease in countries where rye is much eaten.

The cereal group require added to them fat, proteid, common salt, and green vegetables or fruits. The Yorkshire diet of bread, cheese, and apples forms in this way a complete diet.

Group II.—The leguminous seeds—*e.g.* peas, beans, lentils. In the fresh young green state these seeds are fairly easily digested, the cellular tissue is comparatively soft, and the contained nutritious principles fairly easily reached by the digestive juices.

Peas and *Beans* are about equal in nutritive value. Both contain a good deal of sulphur, which is apt to give rise to uncomfortable flatulence.

Lentils are richer in phosphates than peas and beans, and contain less sulphur.

Dry Peas, on account of their strong taste, pall upon appetite, and so, with advantage, may be substituted by haricot beans.

Chemistry of Group.—Rich in proteid—chiefly a substance, legumen, allied to casein of cheese; also some albumen, much of which escapes into water when seeds are boiled. They are also rich in carbohydrates. Salts fairly abundant, but phosphates are less than in cereals. Weak in fats; resemble wheat in amount. Require mixture with fats and carbohydrates to form complete diet. Peas and fat bacon, with potatoes, is example of complete diet.

The dry seeds have very hard cellular tissue, and so require prolonged soaking. A pinch of bicarbonate of soda added to water aids in softening process. The water they are soaked and boiled in contains valuable food material (albumen, and if soda is used legumen also), and so should be saved for soup stock. They are more digestible when boiled in soft water. Beans, after being boiled, may with advantage be mashed up and fried with fat, savoury herbs, and potatoes. Mistakes are

often made in taking leguminous seeds as a vegetable with meat; they should be used as a substitute for flesh.

Group III.—Consisting of carbohydrate, mostly in form of starch, and very little other food material.

Potatoes.—Starch, sugar, trace of proteids. Small amount of very valuable *anti-scorbutic* salts in the juice of potatoes.

The method of peeling potatoes, slicing them, and boiling, is wasteful. All the valuable salts, and much of the proteid matter, pass into the water, and are lost. Steaming potatoes in their jackets is a better method. Roasting them is also good, as there is sufficient water in the potato to cook the starch. Perhaps the best and most economical way to cook potatoes is to stew them with meat in the form of Irish stew.

Prepared corn flour, arrowroot, tapioca, sago, semolina, etc., are examples of almost pure starchy foods; and, as far as all practical purposes are concerned, the extravagantly expensive arrowroot has absolutely no more value than the cheaper corn flour.

Beetroot, when young, a valuable food.

Carrots, *Parsnips*, *Salsify*, rather less value than beetroot.

Turnips far less valuable as food, and also liable to cause flatulence and dyspepsia.

Group IV.—Green Vegetables and Fruits—Green Vegetables.—Large quantities of water, much cellulose, small quantities of sugars, gums, and allied bodies. Many very valuable anti-scorbutic salts. Group valuable as flavouring agents, anti-scorbutics, and are natural stimulants to bowel action.

Cabbage contain much sulphur and so apt to cause uncomfortable flatulence.

Cauliflower, one of most digestible of cabbage kind; the flower gives it extra nutritive value; it contains nearly double the amount of the proteid food in common cabbage.

Sea-Kale.—Method of cultivation makes its cellulose softer, and, in a measure, digestible.

Sauer-Kraut.—Cabbage pressed between layers of salt undergoes acid fermentation, and some of cellulose changed into useful carbohydrate food.

Celery.—Rather difficult to digest when raw; easily digested when well cooked. Contains a larger amount of potash than other vegetables, and on this account useful in gouty and rheumatic states.

Onions.—Valuable as condiments and as vegetable. Larger amount of phosphates than any other succulent vegetable, excepting asparagus. Slight laxative action on bowels.

Vegetable Marrow.—Large amount of water, and very little nutritive value.

Rhubarb contains salts known as oxalates. Oxalates are injurious to many people (in large quantities they are deadly), having a tendency to peculiar form of dyspepsia, accompanied with profound depression and suicidal tendency. This is greatly exaggerated by taking such food as rhubarb.

Fruits (succulent).—Low nutritive value, but rich in vegetable salts, they are anti-scorbutics of incalculable value.

Salads.—Vegetables used in salads are valuable anti-scorbutics. The salts are not lost by wasteful cookery. The uncooked cellulose greatly stimulates intestinal action, but is apt to upset digestion, and so cannot be taken by many dyspeptics.

Watercress is often grown in sewage water, and may spread fever and worm diseases. It should be well soaked in strong salt and water, and then well washed in pure or boiled water.

Group V.—Albuminous Nuts.—The Edible Nuts, excepting the Chestnut, are generally very rich in proteid matter and fats; they also contain some carbohydrate. The difficulties in their digestion are exceeding great. These difficulties are diminished by grinding the nuts into fine powder.

Group VI.—Edible Fungi (*Mushroom*, *Truffle*, and *Morell*).—Fairly large amount of proteid matter, but a very great percentage of water makes them a very extravagant food. They are rather difficult to digest.

CHAPTER VII

FOOD ACCESSORIES—ALCOHOL, TEA, COFFEE, COCOA, COCA, KOLA, AERATED DRINKS, CONDIMENTS, TOBACCO

Ethylic or common Alcohol is a product resulting from the decomposition of grape sugar. Grape sugar contains more of the elements that form water than cane sugar. Cane sugar

is converted into grape sugar by combining with water. This occurs in the body under action of digestive ferments; it may also be done outside the body by several external ferments. The decomposition of grape sugar into alcohol and carbonic acid gas is due to the growth of several fungi classed together as yeasts. Wines and beers are examples of sugar-containing liquids in which alcoholic fermentation has taken place. They contain ethylic alcohol, and traces of other alcohols. The other alcohols are generally more poisonous than ethylic; an especially common and injurious one is amylic alcohol or fusel oil. These fermented liquids further contain traces of several acids, and some unfermented sugars. Spirits or distilled alcohols are mixtures of water, alcohols, and several volatile acids. The better spirits consist of ethylic alcohol and traces of ethers, while free acids and the more poisonous alcohols are practically absent. Age improves spirits by a gradual combination of free acids with alcohol to form ethers.

Action of Alcohol on Body.—Strong alcohol temporarily hardens the tissues it touches, albumen is coagulated; this causes burning sensation in the mouth. Local action on mucous membranes is followed by a pouring out of secretions, due to reflex nervous action; the increased amount of digestive juices does not increase healthy digestion, as alcoholic beverages mixed with food delay the chemical action of digestive juices. This delay is far less marked with pure spirits, and least of all with good gin. Alcohol prolongs digestion in healthy body.

Alcohol is absorbed directly into the blood, and then filters with the blood through the liver. Large amounts cause chronic inflammation of liver, and, if habitually repeated, serious if not fatal disease arises.

Action on Heart and Circulation.—Heart beats more rapidly, blood circulated more freely, but action of alcohol on blood and tissues prevents increase of bodily vigour. Blood-vessels on surface of body are dilated.

Action on Blood.—Combines with colouring matter, and diminishes its power of carrying oxygen from lungs to tissues. Diminished oxidation leads to fat deposits, diminished heat production and want of power, and to premature old age.

Action on Body Temperature.—Temperature lowered. Many think alcohol warms body; this in consequence of warm glow

and sense of warmth felt as the heat escapes from the large amount of blood in the dilated surface vessels. Thus alcohol increases loss of heat, and diminishes its production. Alcohol taken before exposure to cold does not "keep the cold out," but lets it in. After exposure, a little alcohol may be taken before going to bed; the heat lost from the body warms the air between the bed-clothes, and then further heat loss is diminished. It is, however, more economical to warm the bed by means of the domestic warming-pan.

Action on Nervous System.—At first increased activity and power of brain is experienced, due to increased circulation; this is soon followed by paralysing action of alcohol on the active nerve tissues. The higher parts suffer before the lower. The highest part is self-control, and man loses his power over himself and his appetites; then follows judgment, then motor power.

The speech motions are generally first to go, then power in directing muscles generally, and lastly vital muscles low down in brain are paralysed, and death results. The above order is seen in an acute case when a man gets drunk. In chronic cases the more permanent weakening of the nervous system is generally in the same order of sequence.

Alcohol as Food.—Probably a limited amount of alcohol is slowly consumed as a combustion food. This amount is certainly very limited—certainly not more than one or, at outside, two ounces in twenty-four hours. Its inconvenience as a food is shown by its other effects on the body. It is valuable in cases when, for some reason, insufficient food is taken. When sufficient food is taken alcohol is unnecessary, if not injurious; when excess of food is taken the addition of alcohol does serious harm. *N.B.*—A large number of people eat too much.

In childhood alcohol as a beverage is most injurious; *in adult life* a strictly moderate amount (p. 32) with ordinary diet (p. 20) may be taken or not, but it is not necessary. *In old age, with failing strength and weight*, alcohol is most useful; *in old age, with increasing weight and obesity*, alcohol is most injurious: it increases the tendency to fatty heart troubles, and to apoplexy, with paralysis or sudden death.

Moderation for adults may be defined as one ounce of alcohol daily—*i.e.*

1 pint of fairly strong Dinner Ale .	about	=	1 oz. alcohol.
$1\frac{1}{2}$ pints light Table or Lager Beer .	,,	=	,,
$\frac{1}{2}$ pint light Claret	,,	=	,,
2 wineglasses of Port or Sherry .	,,	=	,,
3 or 4 tablespoonfuls distilled Spirits	,,	=	,,

Total abstinence in adult life is often necessary. Each man should test his self-control in the following way:—Having fixed a daily allowance (say one ounce of alcohol), he must make up his mind not to exceed it. If he cannot keep to the limit total abstinence is imperative; each time the limit is exceeded his self-control is weakened, and he is on the high road to a dreadful disease—dipsomania. Those who have once been victims to alcoholism, and have broken the habit, must absolutely abstain for the rest of their lives.

Individuals of gouty families should generally be teetotallers. If alcohol is taken the beverages in which alcohol is mixed with some unfermented sugar must be avoided. Well diluted distilled spirits do the least harm.

Tea and Coffee.—These substances contain active principles, known as thein and caffein respectively, which act similarly on the body; they are excitants to the nervous system. They act on heart in small doses as a tonic, in excessive, or too frequent doses, make its action irregular and weak. Tea also contains a volatile oil that is an irritant, and increases stimulation of nervous system, sometimes to the extent of making patients nervous and irritable. Tea also contains much tannic acid. This, together with volatile oil, irritate stomach, and in large does upset digestion. A volatile oil also develops in roasted coffee, but it is less irritating than that of tea. Green tea is more irritating than black tea. Contrary to popular idea, prolonged infusion of tea does not make it more injurious, apart from the fact that a stronger infusion is made. The plan of pouring boiling water on tea, and immediately pouring it off and throwing the leaves away is only wasteful. Less tea leaves and longer infusion makes tea that is no more injurious.

Tea, on the whole, is more injurious than coffee; both, however, are bad when taken in excess. Addition of bicarbonate of soda to tea infusion largely counteracts injurious action of tannic acid. The greatest dangers of tea and coffee lie in

the fact that men often use them to enable them to continue working when the system is exhausted. If this be continued a break down must result. Poor people often do great harm to digestive organs by diminishing their food and frequently taking tea.

Cocoa contains a similar alkaloid to tea and coffee. It is, however, present in smaller quantity, and the way cocoa is generally taken the whole seed is eaten, and so, in addition to a stimulant, some food matter, principally of a carbohydrate kind, is taken. It is, however, inconsiderable in amount, as the total weight of cocoa eaten is so small.

Coca, *Kola*.—Condemnation cannot be too strong in regard to habitual use of these drugs. They contain stimulating alkaloids whose action on the system is insidious, and a craving is often set up that leads to a form of insanity known as cocainomania. Unhappily, this is increasing at the present day. Great danger lies in habitually drinking coca wines, in taking cocaine-containing snuffs, and foods similarly drugged.

Such drugs should, above all others, be only taken under constant medical supervision. The cocaine habit, certainly, can sometimes be broken more easily than opium or alcohol, but the weakening of the mind is more lasting.

Aerated Drinks consist of water, or solutions of salts, with, or without, sugar and flavouring agents, aerated with carbonic acid gas. Carbonic acid gives a brightness to the water, and pleasant flavour. Providing no metallic poisons are added from lead, etc., in machinery used in preparing the waters, simple aerated waters are not injurious. Potash and lithia waters are useful beverages for gouty people.

Condiments.—Large quantity of spices, hot peppers, etc., are most injurious. For the time being they apparently aid digestive action; they increase appetite. Constantly taken they eventually set up a chronic condition in stomach that leads to a shrivelling up of the active digestive gland tissue, and a permanent and practically incurable form of indigestion is set up. Many of the quack remedies sold for digestive troubles relieve in this way for the time, but in the end do permanent harm.

Tobacco.—Most injurious to those under age of 21, and to sufferers from digestive, heart, throat, or eye affections. $1\frac{1}{2}$ oz. (weekly) smoked in clean pipe, after food, should be healthy adult's limit.

CHAPTER VIII

FOOD FOR INFANTS

The importance of this subject is enormously great. The death-rate among infants is fearful and shocking; fearful from the fact that *over* 140 *out of every* 1000 children born in England and Wales die before they reach the age of *one year*; shocking from the fact that a great number of these children are literally starved to death. Plenty of food is given them; plentiful and destructive excess is swallowed by the delicate infant, and excess of a material it cannot digest, the result of which feeding must of necessity be discomfort, pain, and wearisome wasting away to a slow but certain death.

Milk is the natural food for young animals, and milk of its own kind, and, best of all, the milk of its own mother. Milk of different animals differs in its composition, and the young of these various animals require a correspondingly different nutriment for their proper growth and development.

The young human infant should always be fed by its mother in its early days. Unfortunately, this is not always possible. The only allowable impossibility should be such a condition of the mother's health that she is unable to supply the infant with milk sufficient in quality or quantity. Occupation and frivolous pleasure-making are sometimes the reasons why mothers do not nurse their own children. The first of these —viz. *occupation*—is hard to obviate when the mother is the bread-earner for the family. Employers of women should allow time for this; selfishness or stern necessity at times prevents it; then we can merely feel how regrettable it is that that woman has become a mother; pity, not blame, is all we can feel. In the case of frivolous pleasures of society preventing the mother nursing her child, condemnation must be expressed in unmeasured terms. It tells upon the child's health in infancy and after-life. It tells also on the mother's own health. Punishment surely follows every breach of Nature's laws.

In the feeding of very young infants there are many points of importance, especially when artificial food is given.

In all cases the child must be fed at regular intervals. The

practice of giving the child meals irregularly makes the child, after a longer fast than good, take too much at one time. Sickness, indigestion, and fretfulness result. If the infant is asleep when its meal-times comes, *wake it up*. Mothers have a great dislike to doing this, but there should be no hesitation about it. The child will sleep again, and sleep far better and have better health. Neglect of this rule is a common cause of crying babies. A baby in the house ought not to mean a disturbed house. It is an unnatural thing for a baby to cry; it is generally the result of disease brought on by want of care, or ignorance.

The following table shows at a glance the intervals that should be allowed between meals in the case of young infants:—

TIME FOR MEALS.

First three months of child's life	Every two hours during daytime. Every three hours at night.
After three months . . .	Every three hours during daytime. Every four hours at night.

After the child has finished its meal its mouth should be washed out and the nipple sponged clean. The nursing mother should take a plain, wholesome diet, and should avoid all richly-seasoned dishes, wines, etc., and, in fact, follow out the rules of health most scrupulously as regards exercise, fresh air, and food.

In cases where the child has to be fed on cow's milk the following rules should be attended to:—

TOTAL AMOUNT TO BE GIVEN.

Second day	$\frac{1}{4}$ pint.
Third day	$\frac{2}{3}$ pint.
Fourth day and first month	1 pint.
Second month	$1\frac{1}{4}$ pints.
Third month	$1\frac{1}{2}$ pints.
Fourth month and after	$1\frac{3}{4}$ to two pints.

Cow's milk differs considerably from human milk, and so in giving it to infants it requires special preparation. The following simple rules should always be attended to:—

(1) Cook (see p. 112) the milk directly it comes into the house.

(2) Have all the vessels in which the milk is put absolutely clean—they had better be all boiled each time before use.

(3) Dilute the milk with boiled water, and then add one tablespoonful of fine white sugar to the pint.

The amount of boiled water added to the milk depends upon the age of the child, and upon individual peculiarities. As a rule, the more diluted milk is more easily digested; but, if the milk be diluted beyond a certain point, the infant has to take such an excessive bulk of food that disease results. The following table gives the maximum dilution allowable at different ages. It is well, on commencing to feed a child on cow's milk, at first, to give the maximum dilution, and then cautiously to increase its strength :—

First month . . .	One part cooked milk. Three parts boiled water.
Second month to Third month . .	One part cooked milk. Two parts boiled water.
Third month to Fifth month . .	Equal parts of boiled milk and water.
Sixth month and onward .	Pure boiled milk.

Infants and children are often infected by milk with consumption, diarrhœa, diphtheria, scarlet fever, and typhoid fever.

On this account the milk should be cooked, unless absolute certainty exists regarding its source. Such certainty is difficult to obtain and beyond the reach of the majority. The nutritive effects of milk are somewhat impaired by boiling, less so by the process described (p. 112). The results of this deterioration of cooked milk become trivial in comparison with the fearful dangers of diseased milk.

A more elaborate preparation of cows' milk for infants, is the following :—

(1) Let half-a-pint of new milk stand for twelve hours, and then skim off the cream and put it aside for after use.

(2) Curdle the skim milk with a piece of rennet (*i.e.* warm the milk and put in a square inch of rennet, and let it stand in warm water until well curdled).

(3) Break up the curd, let it stand a few minutes, then drain off the whey and boil it.

(4) Mix two teaspoonfuls of cream with two-thirds of a pint of new milk and boil together, and then mix it with the boiled whey, and feed child on the mixture.

The above preparation is sometimes rather too strong for very young infants, in which case a little more whey or less new milk should be used.

When milk prepared in any of the above ways does not agree with the child, the advice of a doctor must be taken as to what food is required.

Undigested starchy foods are worse than useless. A young infant cannot digest such food, and it ferments and causes disaster. Arrowroot and corn-flour are examples of the worst of all matter given to babies. They merely act as poisons.

Experiments in giving a variety of foods to young babies by the ignorant, generally result, if not in death, in permanent disablement of health and welfare in the child's present and future life.

Progressive Change in Diet for Older Children.

After six months.—Slightly thicken milk with boiled fine whole meal flour, or malted food or scalded rusks.

At eighth month.—Add broth or beef tea to other diet, beginning with about half-a-teacupful daily.

At tenth month.—The child should be completely weaned.

At fifteenth month.—Child to have boiled bread and milk. Scraped meat and gravy, in addition to other milk diet.

At second year.—Four regular meals daily, such as:—

Breakfast: Chiefly milk and bread or porridge, with hard crust to bite; an egg occasionally. *Dinner*: With meat or eggs, potatoes and milk. *Tea-time*: Bread and butter and milk. *Supper*: Bread and milk.

Later on add more vegetables, such as green peas, cooked fruit, vegetable marrow, spinach, boiled onions.

The following things should not be given in early childhood, when possible to avoid them:—

Much uncooked fruit, salads, and such uncooked vegetables, nuts, pastry, buttered muffins, richly-buttered tea cakes, etc., rich cakes, tea and coffee, condiments (excepting salt), ham, pork, liver, excess of meat, dried and salted meats, and, above all, alcoholic beverages.

CHAPTER IX

THE ATMOSPHERE

The atmosphere is a mixture of gases. Its average composition is—

Oxygen	20·96 per cent.
Nitrogen and inert gases . .	79·00 ,,
Carbonic acid gas . . .	0·04 ,,
Ozone, organic matter, minerals .	Traces.
Ammonia water, nitric acid .	Traces.

Oxygen is a colourless odourless gas. It is the active agent of the atmosphere, an absolute necessity of life.

Nitrogen may be looked on as an inert body. It is also an odourless, colourless gas. Its presence in the atmosphere is necessary for the economy of nature. If the air consisted of a larger proportion of oxygen combustion processes would go on too rapidly. A lighted candle plunged in a jar of pure oxygen burns almost with the brilliancy of the arc electric light, and is rapidly consumed; if plunged in a jar of nitrogen it ceases to burn, oxygen being necessary for combustion. Animals in nitrogen die for the same reason. In the air the candle burns at a moderate economical rate.

Carbonic Acid Gas is a much heavier gas than oxygen and nitrogen; like them it is colourless and odourless. Like nitrogen, it will not support combustion or life. It is not, however, an inert gas; it is a serious poison, and so would do harm, or cause death, if existing in the air in large amounts, whether the oxygen be reduced or not.

Ozone is a very active form of oxygen; it readily oxidises substances at ordinary temperature, and without aid of other agents. It acts as a purifier, and a destroyer of germ life, by oxidising organic matter and germ tissues. Its presence in traces is useful; it is formed under influences of sunlight in presence of moisture, and during electric discharges. It is rapidly used up in towns, and so is found most freely by seaside and in country air.

Water Vapour varies in amount according to temperature. A moderate amount is useful; it should not be enough to

make air feel damp. The actual amount required to do this is far less in cold than in warm air.

The other constituents are injurious impurities, and the less of them in the air the better.

Some Properties of Gases

Gases, like solids, possess weight. Some gases are heavier than others. If a cork be placed in a vessel of water it rises to the surface and floats there; if a piece of lead be dropped in it sinks to the bottom and remains there. If a jar of a light gas, as hydrogen, or the mixture of coal gas, be emptied in a room, it rises towards the ceiling; if a heavy gas, as carbonic acid, be poured out in the room, it sinks towards the floor. Unlike the cork and lead in the water, the gases in the room will not remain long in their different positions. The air and hydrogen, the air and carbonic acid gas will gradually diffuse into each other, and in a comparatively short time the gases will be evenly mixed throughout the room. This process is known as the *diffusion of gases*. Gases when heated expand, and so become bulk for bulk lighter. Thus, even a heavy gas such as carbonic acid, if warmed above the temperature of the surrounding air, expands and becomes lighter, and then may rise to the ceiling instead of falling to the floor. On this account, in a badly-ventilated room, the air warmed by respiration and combustion, rises to the ceiling, and a layer of close, warm, and bad air will be found in the upper part of the room.

Air possesses weight, and extends for miles above our heads: it, therefore, exerts considerable pressure at the surface of the earth—*i.e.* about 15 lbs. to the square inch is exerted in all directions. If the air be removed from a thin glass vessel, the outside pressure, with extreme violence, smashes the vessel into tiny fragments; if the wall of the vessel be strong enough to resist the pressure on opening it, the air, forced on by atmospheric pressure, rushes in with great rapidity.

CHAPTER X

VITIATION OF THE ATMOSPHERE AND VENTILATION

THE air becomes impure in several ways. The chief sources of impurity are :

(1) Products of respiration of men and animals.
(2) Products of combustion.
(3) Products from decomposition of animal and vegetable matter.
(4) Particles of dust.
(5) Certain gases, etc., resulting from manufacturing processes.

These injurious products of respiration are an invisible gas called carbonic acid gas, certain putrescible and putrid substances, water vapour, and in some diseased states the germs of disease.

These substances pass out of the body and mix with the air. If they are well mixed with a very large amount of fresh air, as is done during outdoor life, all is well, but if they are breathed over again, even in moderate quantities, they do harm, and if enough is taken they destroy life.

The most dangerous chemical products of respiration consist of particulate and gaseous, putrid and putrescible, organic matter. It is a more or less sticky mixture, and will not diffuse so readily as the carbonic acid gas. It readily adheres to curtains, etc., and thus is not so easily removed from heavily furnished rooms by processes of ventilation. Cigar smoke may be compared to it in its difficulty of removal.

The dangers arising in consequence of breathing the air of a badly-ventilated room, when it is laden with the products of respiration are most serious.

Even when the severer acute symptoms of faintness, sickness, or death are not produced in consequence of the small doses inhaled, many very bad results arise from the continuous taking

of such small doses. Prominent among these evil consequences are :

General conditions of weakness and anæmia.
Great liability to catch any passing disease.
Consumption.
Rickets.
Dyspepsia.
Bronchitis.
Pneumonia, and various fevers.

The injurious products of combustion are various; they differ with different combustibles. The majority of substances we burn in order to get light and heat produce the poisonous carbonic acid gas, and also water vapour and certain compounds of sulphur. Another much more deadly gas may result from combustion, especially if the combustion is slow with a small amount of air used in the process: it is called carbon monoxide. This gas disables the active part of the blood; less than one part of it in a hundred parts of air will cause death with great rapidity. Such fatal accidents occur from sleeping near limekilns, from burning charcoal or coke in a room without having a chimney to carry off the products of combustion.

Gas and oil stoves must not be fixed without a flue to remove the products of combustion.

Cast-iron stoves burning coke or coal, which are allowed to get red-hot, pass into the room through the red-hot iron enough carbon monoxide gas to do considerable injury to health. The same thing is likely to occur with a damaged and cracked stove, even when it is not heated to redness.

The small doses of the poison inhaled in this way produce a somewhat heavy, drowsy condition, and the patient suffers subsequently from the deteriorated blood, unfitness to do a good day's work, mental depression and indigestion. Any such stove must be discarded, or so thoroughly lined with fireclay that the walls are prevented from becoming red-hot. All iron stoves should have as large a surface as possible, in addition to being lined with fireclay.

Even small escapes of coal gas into the dwelling are most injurious to health. Coal gas contains a variable amount of carbon monoxide gas, and, in consequence of certain sulphur

compounds it contains, produces sore throat when inhaled for some time. Any smell of coal gas in the house must be immediately investigated and stopped. It is, of course, extremely important that no escape of gas whatever should be allowed in bedrooms. On this account it is always advisable to avoid having gas laid on in the bedrooms, and to turn off the gas at the meter at night when it is not required. A gas jet that is allowed to sing from excessive pressure passes into the air a good deal of unburnt gas. So also do gas stoves when lighted in the wrong way below.

The products of decomposition passing into the air consist of poisonous gases and suspended particles. Among the suspended particles are living germs, and often germs of disease.

Household dust, examined under the microscope, is found to consist of a great variety of things; among them are:

Tarry and charcoal particles.

Cotton, silk, linen, and hemp fibres from clothing.

Salt.

Bits of insects.

Little particles of skin.

Dried sputum and matter.

Pollen dust from flowers (the cause of hay fever in susceptible people).

Powdered hay and straw.

Grains of starch.

Dried particles of excrement.

A great variety of microscopic living germs are found attached to the various larger particles in dust.

Dust, consisting as it does of a disgusting and frequently very dangerous mixture, must be kept down as much as possible in dwellings.

Directions for dusting.—The construction and furnishing of a room ought to be arranged so as to allow facilities for the removal of dust. Heavy curtains and similar drapery are arrangements well suited for the accumulation and preservation of dust, so also are thick flock wall papers. These things also absorb and then continually give out in small doses, to the detriment of the air, the putrid organic products of respiration. Large numbers of books in open cases, out-of-the-way corners and ledges, elaborate ornamental plaster work round the ceilings and walls, all lead to the accumulation of

dust. Of all dust-catching abominations there are probably none worse than thick Turkey or other thick carpets. Dust is driven out of them when walked on, and when furniture, etc., is moved, and during the occasional process of sweeping, the amount of dust driven out of them into the air is awful and dreadful to contemplate. Floors are better without carpets, or, at the utmost, with small pieces or rugs here and there. When a very bad floor exists some cover is wanted. In such cases a thin carpet that can be easily taken up and removed for shaking is the best kind. When heavy furniture is arrayed round the walls of a room, a carpet completely covering the floor of the room must be avoided, as the trouble of moving the furniture will limit the removal of the carpet for shaking, etc., to the times of spring and autumn cleanings. A central piece of carpet, with polished or stained floor at the sides, or a strip of oilcloth round the walls, forms the best arrangement in such cases. Oilcloth or linoleum completely covering a wood floor is bad on account of the way it encourages the growth of the organism that causes what is known as dry rot.

Dusting a room by merely flapping the furniture, etc., with a dry duster is very little use; in fact it is often done in such a way as to merely distribute the dust throughout the air. Each ledge, etc., ought to be carefully wiped with a damp duster, and, if necessary, polished up with a clean dry one afterwards. The dust in the damp duster should be removed by thorough shaking out-of-doors after the duster has dried outside; or, better still, first soak it in water, wring it out, and then dry it well in the open air. Wood and other floors before being swept should be sprinkled over with old tea leaves, damp sawdust, or some such material to lay the dust, and prevent it being driven into the air of the room. Great and very injurious neglect of this precaution can often be observed in village schools.

A chemical poison is sometimes given out into the air of a room by wall papers containing *arsenic* in their colouring material. In choosing a wall paper one should always get a guarantee that the paper is free from arsenic. The symptoms of slow arsenical poisoning are often not recognised, and so the cause is not removed, and great suffering results. Among the commoner sufferings from such causes are mental depression, occasional diarrhœal attacks, sore eyes, dryness of mouth and

great thirst, and, in bad cases, paralytic symptoms. Such symptoms as these may lead, not only to confirmed bad health, but also, in some cases, to indulgence in alcoholic drinks, in order to give temporary relief, and eventually make the unfortunate individual a confirmed drunkard.

Impurities of the outdoor air are rapidly removed by natural processes, excepting in cases where the houses of a town are closely built together with narrow courts, alleys, closed squares, and courtyards and blind streets. Nature's agents for the purification of air are the winds, the rain, chemical action of the oxygen and ozone of the air under the influence of daylight, and the living processes of green plants during day-time.

The winds act chiefly by removing impurities from places where they are apt to accumulate, as in crowded towns, and then taking them to open spaces, where they are diluted with fresh air, and where the other methods of purification can have full play.

Rain is a mechanical cleanser. It washes the air. Carbonic acid, sulphurous fumes, nitric acid, ammonia, and other injurious gases contaminating the air are very soluble in water, and they dissolve in the rain water, and so sink into the earth, or are carried away by rivers, etc. Solid particles of dust and germs are also carried down by the rainfall.

Processes of oxidation render the foul organic matter resulting from respiratory and other decompositions less poisonous, and in time make them quite inert. Oxidation also is a great germ destroyer. The processes of oxidation are much more active in the presence of bright sunlight and ozone. Light of a yellow or red colour is wanting in certain active chemical action stimulating rays, and so is useless as a purifier. Bright sunlight is rich in such rays. Towns enveloped in yellow smoke-laden fogs and air lose much freshness and health in consequence of the delay in oxidation processes resulting from the obstruction to the active rays of sunlight.

Plant life.—Green plants, during the hours of daylight, respire in exactly the opposite way to animals: they take up carbonic acid gas and give out pure oxygen, and so purify air. During the dark hours of night-time green plants breathe like animals: they use up oxygen and give out carbonic acid. This process is, however, very trivial in amount compared to the much more active process that occurs in the daytime. It

may, however, be looked on as a contraindication to the practice of allowing a large number of growing plants in bedrooms. It is not an uncommon experience to find plants kept in the bedrooms of cottages, where the space is already sadly deficient, and the means of ventilation wofully wanting. The air that passes out of the soil in which the plants grow is also organically impure and damp.

Ventilation of Houses.—In order to understand this problem it is necessary to have a clear conception of, firstly, the amount of air required; and, secondly, the means by which this can be obtained.

A single adult human being at rest will, in the course of an hour, make 3000 feet of air so impure that it cannot be breathed any more without doing harm. On this account it is necessary to allow 3000 cubic feet of air per hour to enter for each person in a room if we wish to keep their healthy vigour up to its full extent. In our winter climate it is practically impossible to change the air of a room more than three times an hour without producing an unpleasant and injurious draught, unless some method is adopted to warm the air before it enters the room. This of course indicates that each individual ought to have 1000 cubic feet of unoccupied space in any room, such as a bedroom, in which he may remain for a prolonged time (several hours).

N.B.—1000 cubic feet of space would exist in a room measuring 10 feet high, 10 feet long, by 10 feet wide. A room 15 feet long, 12 wide, and 10 high would contain 1800 cubic feet—*i.e.* not quite enough for two people, even if no furniture was in the room. A room 20 feet by 15 by 10 high, would contain 3000 feet, about enough for three persons if the room was empty.

Of course all lights burning in a room consume the air, and so extra ventilation allowances must be made for such illuminants.

The following is the allowance generally stated to be required for illuminants:—Two candles, as much as for one man. A gas jet burning three feet per hour will require nearly as much fresh air as two men. Half-a-pound of lamp oil completely burnt would require as much air as three men require in one hour.

A large number of people find that it is impossible to live in houses large enough to secure even this minimum amount of

space for each individual in their bedrooms. This of course indicates the extra necessity there is to have free ventilating openings in such rooms. On this account it is a matter of very serious necessity to allow the windows of such rooms to be open more or less during the time it is occupied; also to see that the chimney is not blocked up. All bedrooms ought to have chimneys in them; if they have not, it becomes necessary to keep both door and window open.

Even when a very large room is occupied the necessity of openings for ventilation is still great, if the room is occupied for several hours. After the first air of the room has been used, then each individual in the room still requires his 3000 cubic feet of fresh air to enter every hour.

The practice prevalent in so many places of closing up all openings in the bedroom in order to keep out the night air is responsible for a great deal of harm, very many cases of consumption have their start favoured and fostered by such habits. We must not be misled by notions about the injurious effects of night air. The foul matters breathed out of our lungs are far more serious and injurious in their action upon our frames than any property possessed by the night air in this country, excepting perhaps in one or two marshy districts, where ague is very prevalent.

The question of air space in schools is most important. Many children suffer grievously from ill-ventilated schoolrooms. At the very least 1500 cubic feet of fresh air per hour should be allowed each child. In many schools only 80 cubic feet of space are allowed each child, when the very smallest allowance should be 150 cubic feet, and then it is evident that the air will have to be changed ten times an hour in order to supply the minimum 1500 cubic feet of air. In the winter this practically necessitates warming the incoming air. Ventilation problems therefore require detailed consideration by architects and managers of schools, and it is necessary to expend money on this object.

The natural agents made use of in ventilation of houses are —(1) *Diffusion of Gases*, (2) *Winds*, (3) *Expansion of Gases by heat.*

The property of diffusion is of comparatively little importance as a means of fresh air supply, but its importance is not insignificant in the getting rid of foul air. By it the air

of a room is rendered more uniform in character, and so the various outlets in different parts of a room all take out a proper proportion of impurities.

The wind is a most important agent in house ventilation, and is the means mostly relied on in the summer time.

Winds act in two ways, by aspiration and by perflation. The wind aspirates or draws the air out of a room through a chimney shaft. A current of air moving horizontally across a vertical tube with a level opening sucks air out of it. Thus, in fig. 2, the wind is blowing in the direction of the arrow AB over the opening of chimney shaft C. In consequence, upcast currents are started in the chimney in the direction of the arrow D, and so air is removed by the aspirating action of the wind from room E. Perflation, or blowing through a house, is a more important action. The wind not only blows through large openings in walls of houses, but also, to a certain extent, through the pores of bricks, mortar, stones, etc.; the latter air is not usually of the purest description. The following list gives the order of porosity in common building materials:—

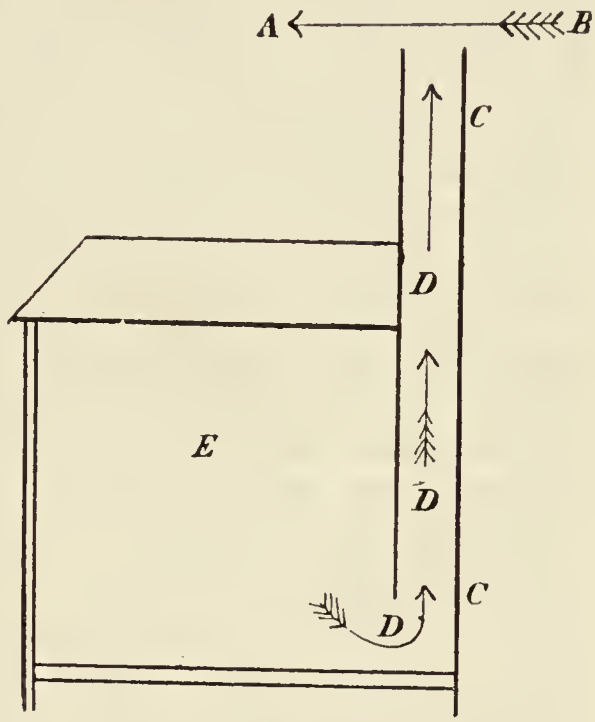

Fig. 2.—Aspiration by wind.

(1) Mud.
(2) Limestone.
(3) Brick.
(4) Quarried limestone.
(5) Sandstone. (Galton.)

The perflation by winds can be made to do an enormous amount of ventilation with open windows on opposite sides of a room, one of which is facing the quarter from which the wind is blowing.

With such an arrangement of windows, and a gentle breeze blowing at the rate of about two miles an hour, it is possible

to change the air in a room several hundred times an hour. It is obvious that such a rapid method cannot be made available in this country, excepting in the summer time, unless we use openings of a less crude description than the ordinary sash or casement windows and ordinary doors. Moreover, the wind is uncertain, and so some other method must take its place.

Room Ventilation.—A simple experiment illustrates the necessity of having separate inlets and outlets in a ventilation system. Place a well-cut lamp chimney over a burning candle on a smooth table: the candle goes out, although there is a large opening above. The entering air meets the outcoming air, and they counterbalance each other, and so no fresh air enters. Raise the chimney a little from the table, and the candle continues to burn—air enters below and comes out above; or, divide the chimney into two compartments by a wood slip or central tube, and the candle will continue to burn. In the latter experiment if a lighted match is held on the outlet side of the slip of wood the match is extinguished by the products of combustion from the candle; if held on the inlet side the combustion products of the match extinguish the candle.

The simple experiment of going into a room in which a fire is burning and holding a candle to the key-hole is very instructive; first close the door and windows and try the experiment, and the flame of the candle is blown inwards by a gust of air entering the key-hole. Then if the windows are opened and the candle again held to the key-hole it will be found that air has ceased to enter the room in this way, for the flame burns steadily upwards.

The reason of this is evident: the fireplace is acting as an outlet, and air is being drawn from the room and passed up the chimney. An ordinary fire in an open grate can extract in this way from 10,000 to 15,000 feet of air per hour from the room. Fresh air must enter to take its place. This air enters by the easiest and most direct channel available. If the windows are open it comes directly from the outside through them; with such an easy entrance the air will not take the trouble to squeeze through the key-hole and chinks of the front and back door, then perhaps down a long passage, and may be up a flight of stairs, to again inconvenience itself by squeezing through so uncomfortable a passage as that afforded by the

key-hole of the room. Air that has had to travel such a roundabout way is very likely impure; it picks up house dust on its way, it may be contaminated by escapes of sewer air from bad drains and water-closets, or some of it may have passed up into the house through the soil, and such ground air is always extremely impure and may contain the germs of such diseases as diphtheria, typhoid fever, rheumatic fever, diarrhœa, and other serious disorders. (Fig. 13, p. 59.)

Inlets for the fresh air to enter directly from outside may be secured in various ways. They are most easily obtained by the windows. When a house is built, regard should always be had for ventilation. Chimneys, or special openings in the walls, as well as windows, should be made in every room.

We should not rest contented merely because we have ventilation openings directly into the outside air, but must also satisfy ourselves in regard to two or three facts concerning these inlets. These facts are:

1*st.* Is there any source of contamination of the outside air

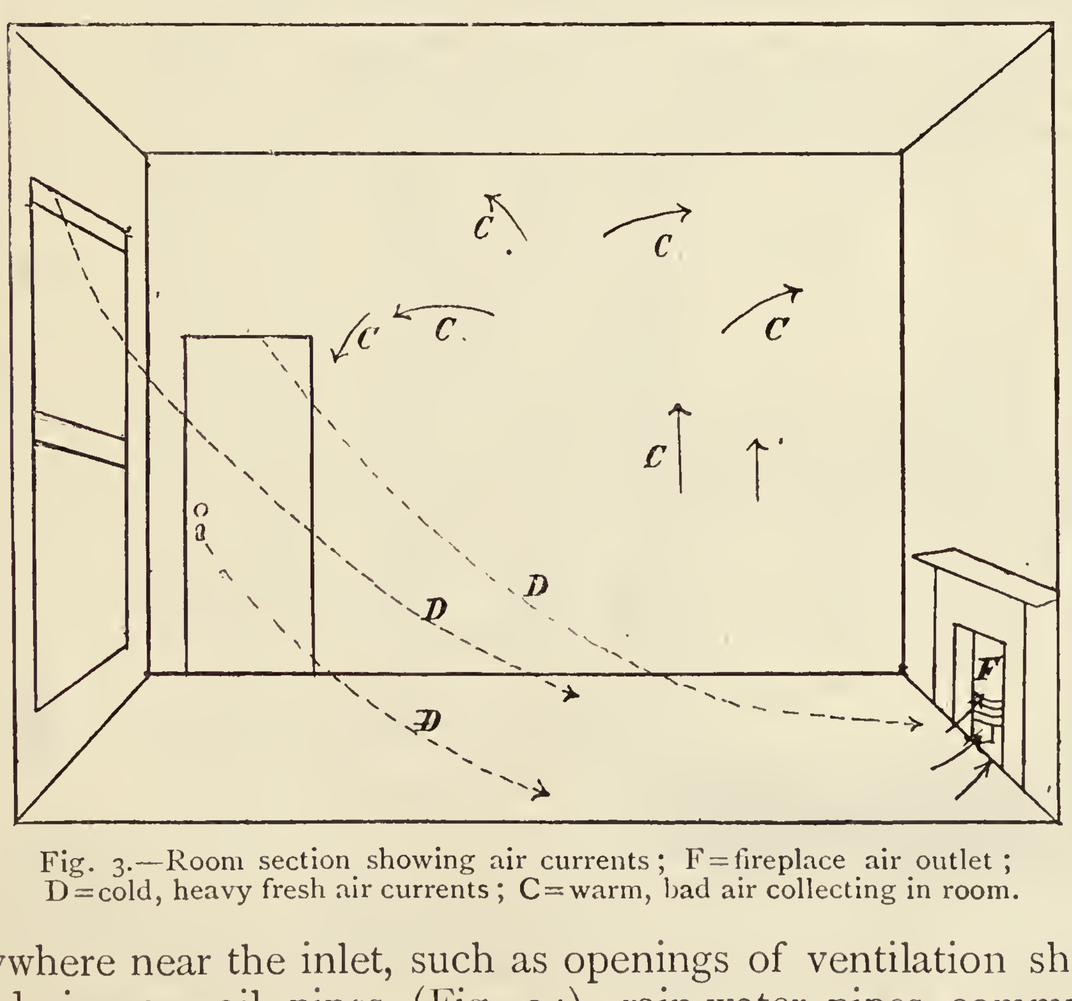

Fig. 3.—Room section showing air currents; F=fireplace air outlet; D=cold, heavy fresh air currents; C=warm, bad air collecting in room.

anywhere near the inlet, such as openings of ventilation shafts of drains or soil pipes (Fig. 24), rain-water pipes communi-

cating directly with drain opening near attic windows, or with their leaky joints near any inlet to the house, untrapped or unclean gullies, any manure heap, pig-sties, cow-byres, and in fact any source of bad smell whatever?

2nd. Is the shaft or opening kept clean and as free as possible from dust and dirt?

3rd. Is the inlet so arranged that the entering air is fairly distributed through the room?

The fresh air entering the room is usually colder than the air inside. On this account it is also heavier. It thus readily falls through the lighter and warmer air of the room to the floor, and if the outlet is near the floor, as is the case with an open fire grate, then the fresh air travels along the floor as a cold draught and passes up the chimney without doing good. (Fig. 3.) To prevent this the inlets should be several and not a single large one, and, better still, the entering air should pass through openings that direct it upwards.

In sash windows a board (W, Fig. 4) (C, Fig. 5) filling the lower part of window frame, fixed under the lower sash so as to raise it above the upper, causes the air entering between the sashes to flow upwards into the room. (See arrows, Fig. 5.) In casement windows double panes fixed in the window with a space open to the outside and inside between them serves the same end. If the panes are very small a few may be omitted here and there. If the panes are large we may omit one, and to prevent a draught fix a piece of coarse muslin over the space.

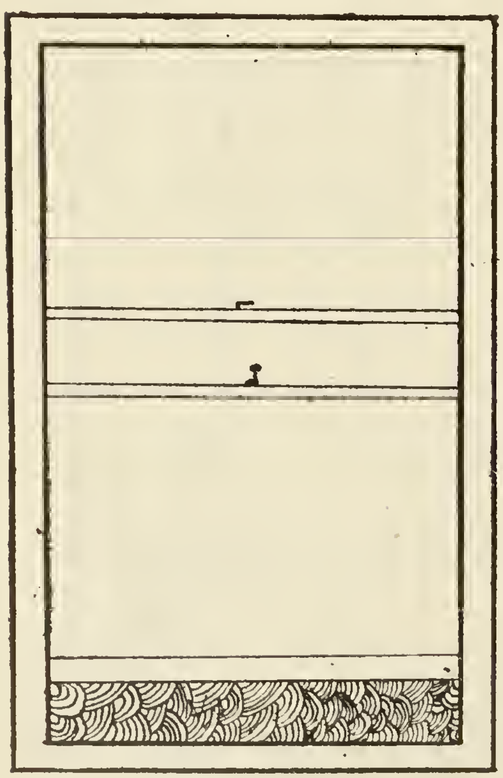

Fig 4.

Fig. 5.
C = Board; A and B = Windows; D = Outside air.

Fig. 6 shows another window ventilator in section. L L L L indicate louvred panes, made to open or

close (open in diagram). P P section of part of window pane. Arrow represents upward direction of incoming currents.

Fig. 6.—Louvred Panes.

Fig. 7 shows a special wall inlet, known as Sherringham's valve. It should be placed in outside wall near ceiling, as far as possible from outlet of room. O = outside opening with grating. V = section of valve. W = wall. C = ceiling. Arrows indicate direction of incoming currents.

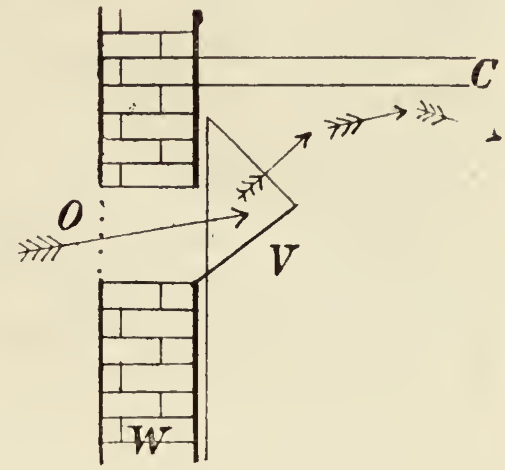

Fig. 7.—Sherringham's Valve.

Fig. 8 is a diagram of another special wall inlet known as Tobin's tube. O = opening in outside wall leading to tube, into which air enters. I = opening of tube into room, which should be six or seven feet above floor, and far away from main outlet. Arrows indicate direction of incoming air.

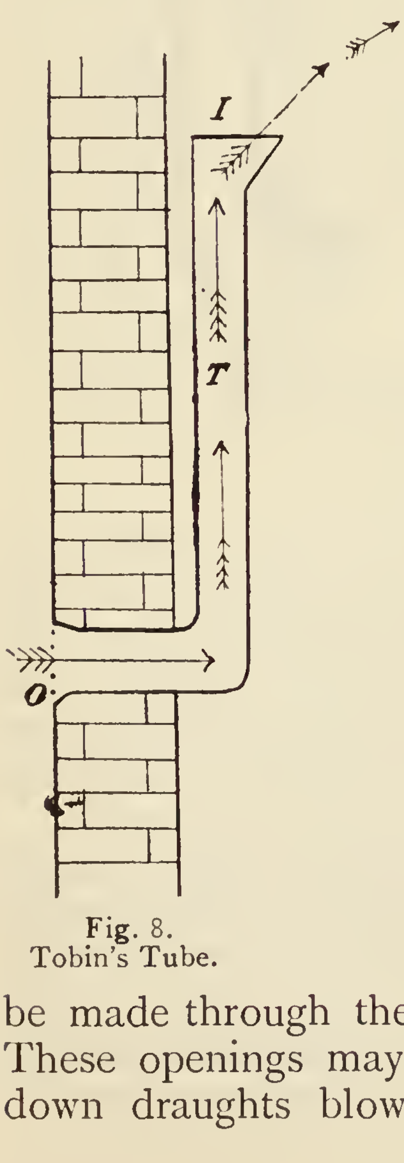

Fig. 8.
Tobin's Tube.

Fig. 9, another wall inlet, consisting of Ellison's perforated bricks. These are built in wall near ceiling. Openings are conical, the smaller opening in outside, and incoming air is spread out on entering room, and so does not so easily fall to ground.

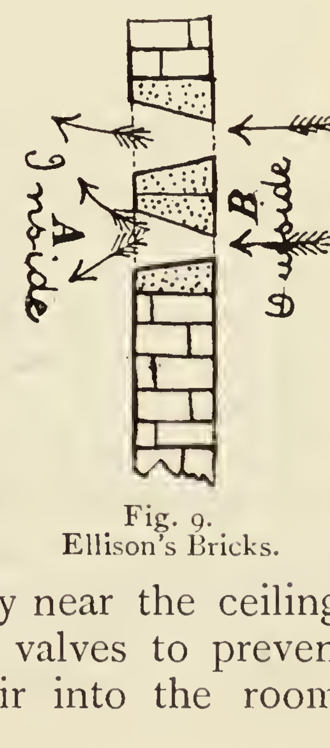

Fig. 9.
Ellison's Bricks.

Chimney outlets may with advantage be made through the wall into the chimney near the ceiling. These openings may be protected by mica valves to prevent down draughts blowing smoke and bad air into the room.

Double chimneys are better, when expense does not exclude them.

Fireplace may be made a combined inlet and outlet, and be arranged to warm incoming air by waste heat from back of grate. The Galton grate is an example of this, and illustrates the form introduced many years ago by its inventor (fig. 10), Sir D. Galton, and is perhaps the very best form of winter ventilation for dwellings. A chamber A having an open shaft to outside air is built behind the grate, from it a fresh-air shaft; B B passes up, and has an inlet to room near ceiling. Air

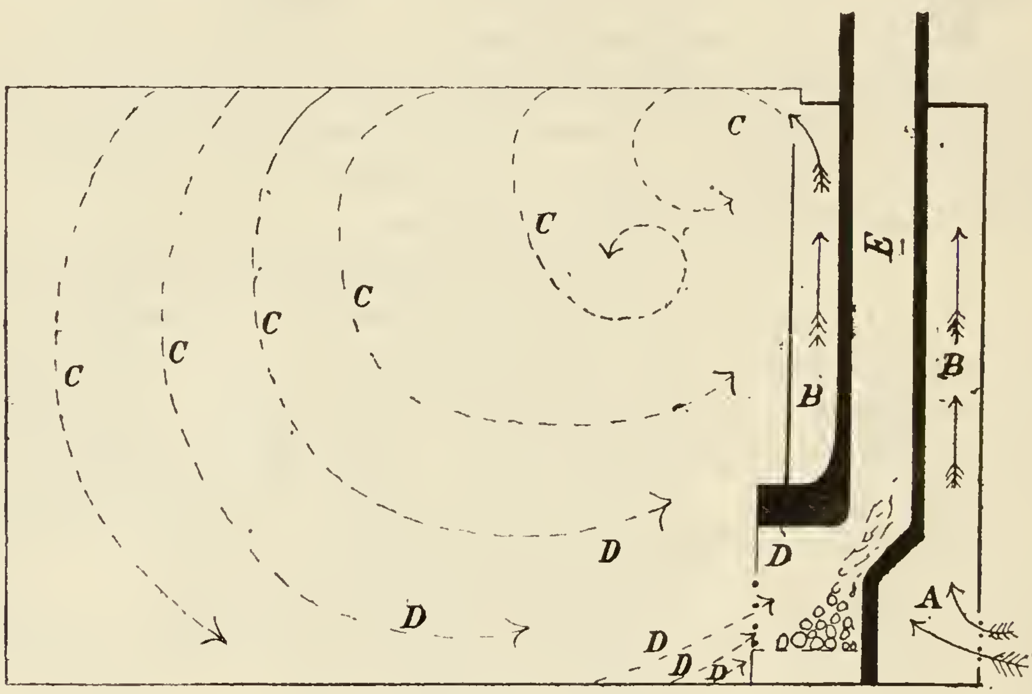

Fig 10.—Galton's Grate.

in A is warmed, expands, and rises and flows into room at C, while fresh supplies enter below. The current of fresh warmed air circulates throughout room, as represented by arrows; and then, as it gradually becomes impure it is extracted by fire at D, and passes out by smoke flue. Coal and gas stoves are constructed on same principle, and it can be applied to hot-water radiators.

Back-to-back houses, and houses without any opening through them, cannot be properly ventilated. Such houses are always most unhealthy, and an excessively high death-rate is inevitable where they exist.

Tests for Air Contamination.—As the respiratory carbonic acid bears a fairly accurate relation to the organic matter, and

it is easier to determine its quantity accurately, the amount of carbonic acid is taken as the standard of impurity allowed. The total should not exceed 0·6 per 1000—*i.e.* respiratory carbonic acid 0·2 per 1000—in any room inhabited for a long time.

Test by Senses.—When the organic matter represented by 0·2 respiratory Co_2 is present the air would have a close smell to any one suddenly entering from without; when it gets much above that represented by 0·4 (total carbonic acid 0·8), the air is very close and disagreeable.

People in a room gradually becoming foul are not able to detect the smell. Travellers in a railway carriage often sit in foulest air in sublime unconsciousness. A new-comer into such a carriage is at once disgusted. The ills of a long railway journey are largely due to bad air.

Simple Chemical Test.—Take a $10\frac{1}{2}$ oz. white glass, wide-mouthed, stoppered bottle, with a $\frac{1}{2}$-oz. mark, fill it with boiled water, and then empty it in the room, the air of which it is required to test, and then rapidly pour in $\frac{1}{2}$-oz. of fresh lime water (a $\frac{1}{2}$-oz. pipette of lime water emptied at bottom of bottle is a more accurate method); stopper the bottle, and shake it up well. If the lime becomes turbid there is over 0·6 carbonic acid gas per 1000 present in the air, and ventilation should be increased.

CHAPTER XI

THE SOIL AND SITE OF DWELLINGS

THE health of a community is largely influenced by the condition of the soil and its underlying rocks.

The land in the greater proportion of the inhabited world is formed of stratified rocks. These consist of superposed layers of matter, often showing great physical and chemical differences, and which have been laid down at various eras in the geological history. The strata generally exhibit a more or less distinct slope in some special direction.

A quarry or other section through the upper stratum in any

fertile district shows considerable differences near the surface (fig 11). Three layers may be recognised: they are generally called the soil, subsoil, and rock. The soil is the upper layer; it is dark or almost black in colour (A). It is in nearly all cases derived from the geological formation below, altered by the presence of living, dead, and decomposing organic matter. In some places surface soil contains distant formation, transported by various physical agencies in the bygone past. Permeating the soil in all directions are the roots of grass and other herbage. Below the soil from which it gradually merges is the so-called subsoil (B). This is not so dark in colour, and not disintegrated into such fine soft matter; it closely resembles the rock below, into which it gradually merges, and clearly consists of the same material split up, broken, and altered in arrangement. Into the subsoil the roots of larger plants and trees may penetrate (fig. 11). The rock (C) below the subsoil is the geological formation of the district almost unaltered by the recent action of animal and vegetable life, and less affected by late chemical and physical actions of water and gases. This rock varies according to the formation of the district. Sand, clay, gravel, chalk, or any of the varieties of hard stone may form it.

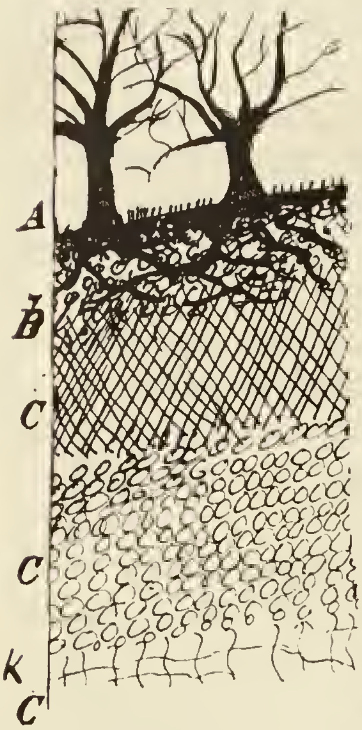

Fig. 11.

Rocks vary in their porosity to air and water. Water can penetrate far more easily through sand or gravel than it can through clay or granite. Clay is an example of a rock tenaciously holding a large amount of uncombined and loosely combined water, and so being almost impermeable to fresh water falling on its surface. Gravel is an example of a rock through which water readily percolates, and which will not hold the water if any way exists for it to gravitate away. Granite is an example of hard rock containing little free water, and on account of being almost impermeable, water falling upon its surface will not sink into it but will run off down any existing gradient.

In cold and temperate climates, other things being equal, damp

and cold soils are less healthy than those that are dry and warm. Another equally important condition is that the air in the ground should be as pure as possible, and the soil not clogged with either animal or vegetable organic matter.

The warmth of a soil depends upon its dryness, its colour, and the physical conformation of the district. The light soil or rock of a chalk district is dry, excepting in hollows here and there, and yet it is a cold soil. White substances reflect away the heat and light and hence remain cold, whereas darkly coloured ones absorb heat. Yellow and red sands and gravel when dry form very warm soils. In parts exposed to prevailing cold winds, the soil is liable to be easily cooled down.

The dampness of a soil depends upon (1) Rainfall, (2) amount of sunshine and temperature of air and winds (p. 61), (3) distance below surface of the more impermeable rock, (4) ease with which the water flows through the ground towards its outlet (p. 56), (5) elevation of area above the surrounding country, (6) vegetation (p. 61).

In practically all porous soils and rocks the pores of the upper part are filled with air, and in the lower part with water. (Figs. 12 and 13, pp. 55, 59.) The water is derived from the rainfall soaking into the ground until it reaches a stratum resisting its farther soakage. If this stratum slopes in any direction, the underground water flows as a subterranean river down to its outlet, which may be a river, spring, lake, or sea; in other cases it may reach large subterranean reservoirs and be stored up for a long time, or flow slowly through them. In Britain the underground water reaches its lowest level in October and its highest in March.

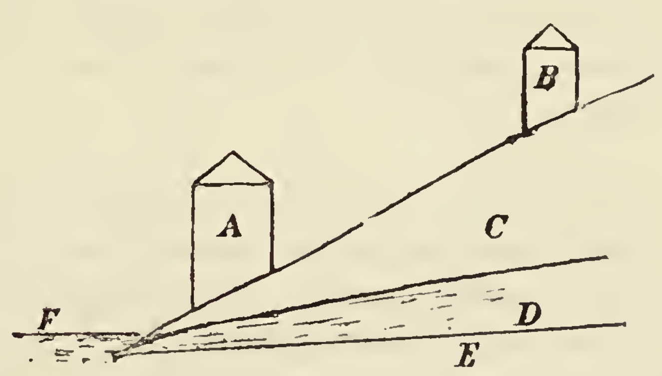

Fig. 12.
Section showing
C = porous rock with ground air.
D = porous rock with ground water.
E = impermeable rock.
F = outlet (river) of underground water.
A = house on soil near underground water.
B = house on dry, healthy site.

A glance at fig. 12 explains how elevation of site and distance of impermeable rock from surface is related to height of underground water and to dampness of soil. It is manifest that house A is less healthy than B.

The ease with which underground water flows to its outlet depends upon several conditions. The following are favourable to it:—

(*a*) A very porous rock—*e.g.* gravel or loose sand.
(*b*) A rock fissured in direction of water flow—*e.g.* chalk.
(*c*) A free opening at the outlet.
(*d*) Non-interference with the flow by roots of trees.
(*e*) Absence of tidal influences in the soil.

Remedies for the absence of the above conditions are at times possible. Porous agricultural drain pipes laid in compact soils have improved the health of districts. Outlets may be improved by attention to beds of rivers, etc. Blocking up an outlet by damming a stream for reservoirs, mills, etc., is always a subject of anxious consideration to the sanitarian; it means the raising of underground water in surrounding districts, and this in some cases interferes with the public health.

When the sea or a tidal river forms the natural outlet for the underground water, its level is affected by the tides. This influence in a very porous soil may be manifest a great distance away from the outlet; but, of course, the farther a place is away from or above the outlet, the less is this influence felt (p. 58).

Ground Air.—The study of conditions influencing the purity of the ground air must be prefaced by a few details about what may be termed the physiology of the soil.

The surface soil is full of organic life. A vast congregation of bacterial germs dwells in it. As many as 2,100,000 have been found in a single gramme of soil (not quite $15\frac{1}{2}$ grains). The majority of these germs do great service—in fact, without them the higher vegetable and animal life could not exist. They prepare the manurial constituents of the soil, so that the latter can be used by plants to build the vegetable tissues upon which our lives depend. Deeper down in the ground there are other organisms that more slowly alter organic matter, and which can do their work without gaseous oxygen; the surface oxidising organisms are the more active and rapid. The soil is, therefore, a vast chemical laboratory, where, always hard at work, is an infinite host of tiny, microscopic chemists, whose chemicals and reagents consist of organic compounds

and ground air. These little chemists are invaluable purifiers of putrid matter. With a good supply of oxygen gas, they readily oxidise organic matter and turn it into compounds incapable of producing bad smells; and, further, they can destroy those bad smells when already existing. Housekeepers at times make use of garden earth to remove smell of fish, etc., from cooking utensils. Darwin, in the "Naturalist's Voyage," refers to the Gauchos burying the fœtid flesh of a deer (*cervus campestris*) in order to remove the otherwise intolerable smell possessed by its flesh. Sanitary authorities use the soil as a means of destroying the dangerous properties of sewage and such-like filth. The soil's purifying power is accomplished at the cost of the ground air. Oxygen is used up, and its place is taken by carbonic acid and other gases more or less injurious to health if allowed to enter a dwelling. The purifying power of the soil is limited unless fresh oxygen can regularly enter. If any special ground area is constantly soaked with organic matter, putrefaction soon takes the place of oxidation, the ground air becomes highly charged with most poisonous and foul gases, and the organic matter soaks down unpurified to poison the underground water. This is especially likely to occur if the area has at the same time its pores filled with liquid or viscous matter. Such a condition exists about and under a soaking cess-pit.

The germs acting in this useful way are not the only inhabitants of the soil: many disease-causing organisms make their home, nursery, and resting-place in the surface soil. Among them are the cholera, typhoid, diphtheria, tubercle, diarrhœa, malaria, lock-jaw. The presence of these germs indicates the urgent necessity of keeping the soil and its emanations from the dwelling, food, and open wounds.

Regular movements of ground air are necessary for health, especially if quantities of organic matter are thrown into soil, but the outcoming air should not enter a dwelling.

The chief factors influencing the movement of the ground air are:

(1) Rise and fall of the underground water level.
(2) Variations of atmospheric pressure (rise and fall of barometer).

(3) Differences between the temperature of the soil and the atmosphere above the soil.
(4) Rainfall and frost sealing up the surface pores.

Factor 1 (p. 57) is self-evident. As the ground water rises it forces the air out of the soil above it; as it falls its place is taken by the air above, and so fresh air is drawn into the soil.

Factor 2 is easily understood. Air possesses elasticity very perfect in quality. With high barometric pressure the elastic air is condensed in the soil, then, when the barometer falls, the pressure being lessened, the elastic air springs out of the soil.

Factor 3 is of serious importance in regard to house construction. The air inside a house is warm and light (see p. 39); air pressure is less in the house than in the soil on which it is built: and so, unless some precaution is taken, foul air, and perhaps disease-causing germs, will be sucked out of the ground into the house.

A 6-inch layer of good cement concrete rammed solid, with asphalt or cement surface, completely under the basement and round the walls of the house, will prevent this danger (fig. 13). Another way to gain this end is to have the house built upon arches open to free ventilation. The necessity for such concrete, etc., is great in tidal districts, or each rising tide will force ground air into the house.

Gravel and other soils having commercial value are dug out, and if pit is required as a building site, it has to be filled. Formerly old house dust and other refuse, being the cheapest available material, was used for this purpose. A house on such an abominable foundation and unprotected from the ground air will be unhealthy for years. Fortunately, the evil is now so well recognised that it is generally forbidden by bye-laws; and in districts that have adopted the Public Health (Amendment) Act of 1890 heavy penalties can be inflicted for building houses on soils impregnated with organic or offensive matter.

The air in the ground under houses is liable to be very poisonous from leaky drains, soaking cesspits, leaky gas mains, emanations from mines, from houses being built on soil made up of house and other organic refuse. Town house yards must be well paved to prevent soakage of filthy liquids. Houses with unpaved yards always have a high death-rate from diarrhœa, etc. The dangers from breathing ground air are

manifestly much greater to those sleeping in basement or on ground floors. Whenever possible bedrooms should be on the first or higher floors.

Ground air may poison food stored on basement, etc.

Factor 4. Directly after a rainfall, movement of ground air is stopped, as the pores on the surface are blocked up for the time being. The same thing occurs during frosts. Gas escap-

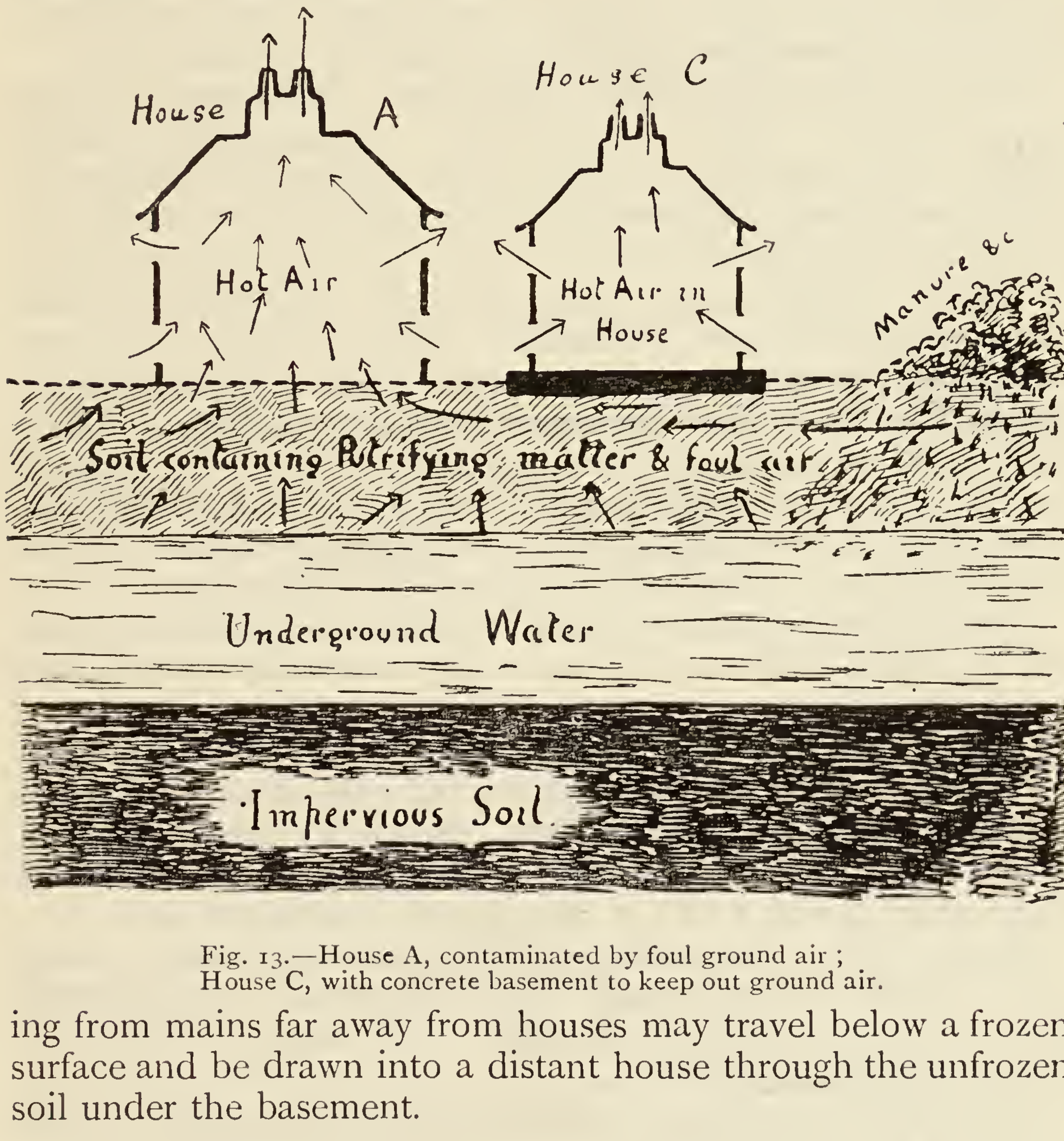

Fig. 13.—House A, contaminated by foul ground air ;
House C, with concrete basement to keep out ground air.

ing from mains far away from houses may travel below a frozen surface and be drawn into a distant house through the unfrozen soil under the basement.

Geological Formations in Relation to Health

Granite, Metamorphic, Trap, and Slate Rocks.—Advantages : Great slope enables water to run off. Air is dry ; rank vegetation not present. Marshes and malaria not general, but localised. Few impurities to drinking water. *Disadvantages* :

Difficulty in regular water supply. Liability to torrents. *Conclusion* : Usually very healthy.

Sandstones of great depth.—Advantages : Dry, warm. *Disadvantages* : Water sometimes contains great quantity of mineral salts. Sewage matter liable to contaminate wells, especially in very porous or fissured stones. When mixed with clay, or underlaid not far from surface by clay, sandstones are often damp, water-logged. *Conclusion* : Deep sandstones, form healthy localities, especially in high lying parts.

Limestone and Magnesian Limestone. — *Advantages* : Great slope, dryness of slope and high land. *Disadvantages* : Rock colder than sandstone. Marshy areas in places are unhealthy. Water very hard. Magnesian limestone has been blamed for production of goitre.

Chalk. — *Advantages* : Hilly country; dry soil on pure chalk at elevated parts. Freshness of air. Water often very pure, despite hardness. *Disadvantages* : Soil is cold. Fissures in chalk at times allow dangerous pollution of water. Marly chalk, and where chalk rests just over clay, are water-logged, marshy, and often malarious. In some hollows of chalk downs sunlight is shut off from houses, and goitre is not uncommon in those places. *Conclusion* : Generally a healthy soil.

Sands, loose.—When of great thickness and hilly, generally warm, dry, healthy sites; when closely underlaid by clay, and water-logged in some recent river deposits with organic debris, they are unhealthy.

Gravels.—Hills with good slope and good depths of gravel are very warm, dry, healthy sites. Water is somewhat liable to soakage impurities. Gravels filling up small basin-like depressions in clay rock are water-logged, unhealthy sites.

Clayey Soils—Disadvantages : Flatness of country; coldness; surface water cannot percolate or run off naturally. Pure water very difficult to obtain. Air damp. *Conclusion* : Generally unhealthy districts.

Recent River deposits generally unhealthy sites. May be much improved by drainage.

Resumé—Soil and conformation in relation to health.—Porous soil healthier than flat impermeable soil. Fairly high lying districts healthier than low lying districts. Slopes are better than flat country. Hilly districts have unhealthy sites, as enclosed valleys, punch bowls, wet boggy country at

entrance of ravines and foot of hills. In flat country, generally speaking, the most unhealthy sites are those somewhat depressed below the general plain level. It is, however, not uncommon to find in plains of stiff clay that diphtheria is, on the whole, more marked on any more elevated and exposed area. House should, if possible, be placed so as to get direct sunlight on both sides of house—*i.e.* S.E. or S.W. aspect excellent.

Vegetation and Health.—Herbage makes ground colder; it obstructs sun's rays, and, despite evaporation from leaves, it keeps ground moister.

Trees are generally healthy. They cool air in hot climates by shelter and evaporation of moisture from leaves, and may in cold climates break the force of cold winds.

Close brushwood with rotting vegetation is generally bad; it favours ague.

Sites exposed to prevailing winds are generally healthy in temperate climates, but much depends upon the health of the individual.

Good tonic or bracing effects of wind especially visible in circulatory diseases. The death-rate from heart and circulatory affections is always greater in places protected from prevailing winds—*e.g.* (1) depressed areas behind high seaside downs, ridges, and cliffs, where sea-wind blows over the area.

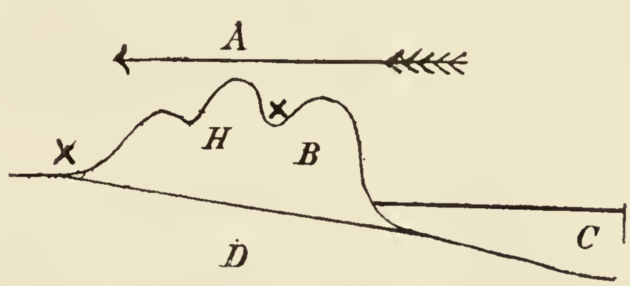

Fig. 14.—A = prevailing sea wind. H B = downs. C = sea. D = deep stratum. X = site shut off from winds.

(2) In river valleys (A) opening out opposite to direction of prevailing winds (fig. 15); in such cases wind blows over instead of through them.

River valleys suit heart cases when they open towards the prevailing direction of winds (B); in such cases the wind sweeps right through the valley. (Fig. 16.)

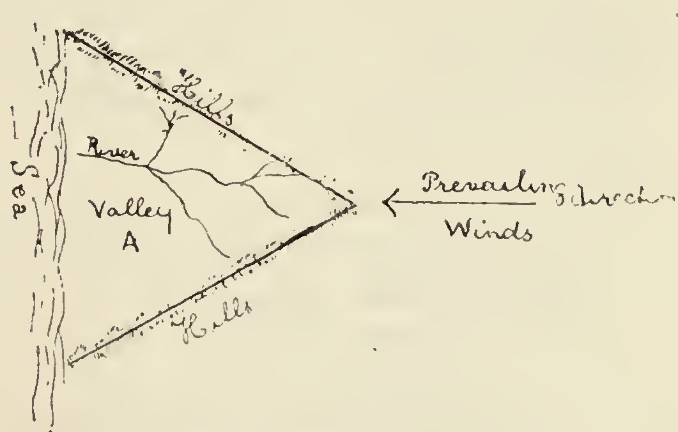

Fig. 15.

Chilling effects of wind are in a measure overcome by clothing and exercise by healthy people, but in cases of consumption and lung disease their ill-results are manifest. Such patients require to live outdoors as much as possible, and so require a place where they can get pure air, and be protected from winds, such positions as described (p. 61, fig. 14)—*i.e.* quite the opposite to those suited for heart cases.

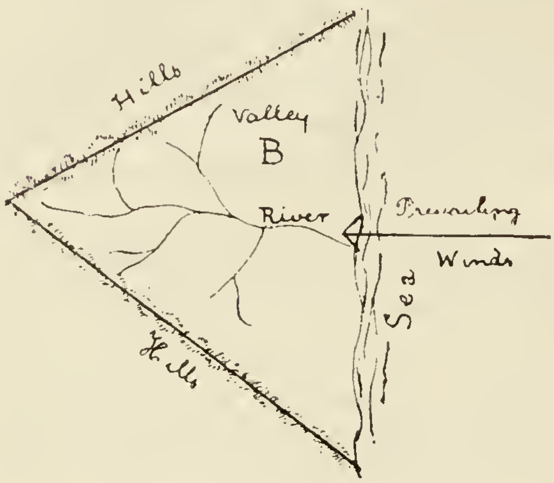

Fig. 16.

Some of the symptoms of heart cases resemble lung cases, and this example illustrates a class of mistakes made from one patient assuming that because a place has suited another it will suit him.

CHAPTER XII

BUILDING IN RELATION TO SOIL AND CLIMATE

Those who dwell in damp dwellings are liable to suffer from rheumatism, and its so called complications, consumption, bronchial affections, sore throats and diphtheria, neuralgia, and various infectious disorders. Evaporation of water from any surface chills it and the air around. People with such chilled surroundings are liable to colds, and under this condition fall easy victims to disease germs.

Among the common causes of dampness in the dwelling are:

(1) Damp soil.
(2) Rain driven into walls by wind.
(3) Leaking roofs.
(4) Absence of rain gutters and pipes, or their bad construction.
(5) Bad mortar and bad bricks.
(6) Faults in drains, water-pipes, taps, cistern ball-cocks, etc.

The evils of a damp soil are overcome by proper drainage, lowering and keeping the underground water at a more constant level. Another important method of preventing the walls of a house becoming damp through the sucking up of the soil moisture is by proper arrangements of damp proof courses, dry areas, and cement basements.

Houses constructed without these, allow the soil moisture to be drawn up by capillary attractions of the bricks, and it will sometimes ascend even to the highest storeys of a house. When once a house is built without such protections, extreme expense is encountered in their after-making.

A damp-proof course is a layer of material impervious to moisture laid through the thickness of the wall all around the house.

For a house without a basement storey, or with a dug area, a single damp-proof course, six inches above the level of the ground and below the lowest wood floor of the house is all that is necessary. The materials for damp courses are various. Slabs of glazed stone-ware are about the best thing for the purpose, these are made specially with holes for ventilating the space below the flooring; this helps to prevent the so-called dry rot.

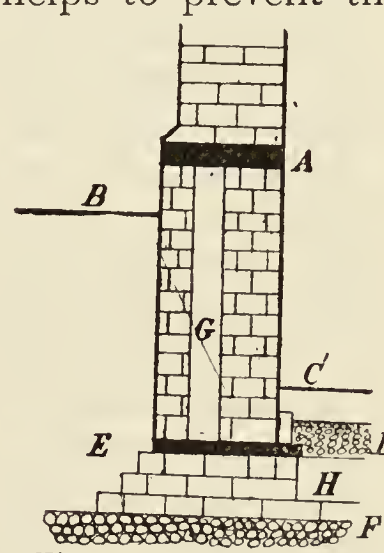

Fig. 17.—A, damp course 6 inches above ground level.
B, ground level.
G, dry area.
C, lowest wood floor.
D, concrete below basement
H, footings.
F, concrete below footings.
E, damp-proof course between footings and dry area.

Another good material is sheet lead. Three or four layers of slate in good cement serve the purpose fairly well. Good asphalt at least three-quarter inches thick is sometimes used with fair success.

In the case of houses with basement below the soil level, an area should be dug at least three feet wide, and well paved and drained below the level of the basement floor. The ground under basement must be well drained. Basements without dug area require dry areas built in the walls (fig. 26). A double wall is built below the ground level with at least two inches space between the two walls. The space should be ventilated and drained. In addition, a damp-proof course is required below the lowest floor, in order to prevent the

moisture passing through the footings to the flooring and inner wall. Another damp-proof course is necessary six inches above the level of the ground in order to prevent the moisture being conducted by the subterranean wall outside the dry area upwards to the walls of the house generally. With these precautions, dryness is attainable.

Driven Rain.—An ordinary brick can absorb about a pound of water. Absorption of rain can be prevented by painting the outer walls of the house and covering them with a layer of impervious Portland cement. This has the desired effect, and is absolutely necessary in the cases of houses with a wall built facing a windy, wet quarter, as is the case with seaside houses built along the front. It must be remembered that in keeping the rain out in this way moisture inside is also kept in. A lot of moisture is formed inside an inhabited house by respiration, combustion, and various domestic operations. If varnished impervious papers or painted inside walls exist, much of the moisture condenses and trickles down these papers and on the window panes. If porous walls and floors exist, the moisture is absorbed, and dampness results. Proper ventilation is the remedy for this condition.

Another method of protecting the walls against the driven rain is to build houses with double walls, joined together by proper bonding ties. These ties should be impervious to moisture and dip in the centre, so that any wet that may reach them will drop down in the cavity and not affect the inner wall. Iron ties should be tarred and sanded. Care must also be taken to remove any mortar that may be dropped in the course of building upon the ties, or it may conduct water to the inner wall. The space between the two walls must be drained and ventilated.

The want of proper rain spouting is a common cause of damp houses. A large number of houses in the country and country towns are absolutely without any spouting; others have spouting, but it has been allowed to get into such a state of dilapidation that the houses would be just as well without any. The ill-effects of this are evident: the rainfall all over the area covered by the house is conducted to the ground at the foot of the walls.

A house built without rain-gutters is pretty sure to have no damp course. In consequence of this, moisture from the

rain-saturated soil is taken up and conducted by the walls to the higher storeys, and results in damp bedrooms, humid, damp, lower rooms, with all their train of evil possibilities. Window-sills ought to be made to project beyond the walls, so that water running down them is dropped on the ground, where it does less harm than if drained directly into the walls.

Leaky roofs are most commonly caused by bad workmanship, bad material, or by bad architectural arrangements.

Flat roofs are generally covered with metal, lead, zinc, or copper being used. Great care has to be taken to have accurate levelling, and to make arrangements at the joints to allow expansion and contraction of the metal. The porosity of the roofing material is a very important matter. Of course, the less porous the better, and the more porous the material is the greater must be the slope of the roof.

Large slab slates require slope of 22 deg. with horizon. Ordinary slates require slope of about 26 deg. with horizon. Stone slabs and tiles require slope at angle of 30 deg. with horizon. Thatch requires slope at angle of 45 deg. with horizon. In slate roofs boarding is better than laths as a material to lay the slates on, and it may be asphalted with advantage. When laths are used the under-side of slates should be pointed with hair mortar. Iron nails must not be used to fasten the slates down with, they rust, break, and lead to leakage; copper or zinc nails should be used. Tiles should be underlaid by asphalt. A 3-inch lap should be allowed—*i.e.* the slate should cover the next slate but one for at least three inches. Thatch is somewhat objectionable, on account of the dust and insects it harbours, and its organic substance is capable of putrefaction under influences of alternate rain and sun. It does not wear well; and, instead of the old thatch being removed, it is generally patched by new. It has, however, the advantage of being very warm. Parapet walls should be protected above; the upper row of bricks may be laid in cement upon tiles projecting from side of wall, or a sloping covering of overhanging slabs of stone placed on the parapet top. Junction of roof with parapet wall is often protected by cement flashings which eventually break away from the brick-work, but proper lead flashings wear well.

Bad bricks and mortar are great causes of damp houses. Bricks should be heavy and hard, and should ring clearly when

knocked together. Hard, well-burnt bricks make dryer and more stable houses than soft ones; they are not crumbled by the frost like soft bricks. The less mortar used the better, and, on this account alone, the mortar must be of the best quality.

Three-parts of clean fine sand with one part of fresh-slaked lime make good mortar. It is important that all clay and earthy matter be excluded. Mortar hardens by chemical change in the lime; it combines with carbonic acid from the air. The hardening process should happen after the mortar is in the walls of the house, and so only little should be made as required. Jerry-built houses with a large quantity of bad mortar are not only unstable structures, but the walls are also much more absorbent. The thickness of the walls is important in the prevention of wet.

Under no consideration whatever should a brick wall be less than nine inches thick. In houses over 25 feet high, or with walls more than 30 feet long, this thickness must be increased for sake of stability. It is not an uncommon thing in rural districts to find a cottage built on the side of a slope, with its back wall for a considerable proportion of its height built flush against the bank of earth: in such case the dwelling must inevitably be extremely damp and unhealthy. Very often a soaking wet cesspit exists on the slope a few yards above the cottage. The moisture in the earth, with its foul load of filth, sinks down to the cottage, soaks into its walls, lies under its floors, and is evaporated to poison the inhabitants and their food. In all such cases a paved and drained open area, three or four feet wide, extending below the lower floor of the cottage, ought to be dug and bricked behind the house. Porous brick floors laid directly on a damp soil are very injurious; these bricks are constantly soaked with moisture from below, and with the water used to wash the floor above. Glazed tiles on concrete should be used for this purpose.

CHAPTER XIII

WATER AND WATER SUPPLY

WITHOUT water there would be no life.

Pure water is a chemical compound consisting of two atoms of the gas hydrogen combined with one atom of the gas oxygen.

Hydrogen and oxygen are chemically very fond of each other. When mixed together in the right proportion and a flame applied they combine with great explosive force and produce water. If an electric current is passed through water to which a little sulphuric acid or common salt is added to conduct the electricity through it more readily, the water is broken up into two gases, and these can be exploded and water reproduced.

Liquid water existing naturally within the reach of man is never chemically pure; it always contains organic matter or mineral salts.

A plentiful supply of water, as free as possible from organic matter, is absolutely necessary for health. In past ages the only habitable districts were those in which a water supply was attainable on the spot. Congregations of men thus came to dwell on the banks of rivers and in places where water was readily obtained. Rivers are the natural drainage of districts through which they flow, and large settlements of men led to a fouling of the river by excremental and other refuse. In this way disease germs found their way into the water, and great epidemics resulted. The old Romans expended huge amounts of labour to construct grand aqueducts to supply their cities with pure water. At the present time, even in sanitary England, there are still places, happily diminishing in number, populated by human beings so degenerate, and in this respect so incomparably more beastly than the ancient inhabitants of Rome, that they rest content to consume the water of a small stream only a little way below the outlet of their sewage material.

Man derives his water supply directly or indirectly from the rainfall. Liquid water, as it condenses in the clouds from its gaseous state, is absolutely pure, but by the time it reaches the

surface of the earth in the form of rain it has become impure. Rain dissolves carbonic acid, sulphurous acid, nitric acid, ammonia and other gases, from the atmosphere, and washes from the air dusty solids. The purest water is the last part of a heavy rainfall. The rain sinks in the soil or flows in streams downwards over surface.

Man secures (1) rain water directly; (2) ground water from wells and springs; (3) upland surface water running down hills in small streams to natural or made lakes; (4) surface water from cultivated lands as land springs, streams, ponds, and dip wells; (5) river water.

A great number of diseases are spread through the agency of impurities in drinking water. The most injurious of these impurities consist of:—1st, decomposing animal matter, especially excretal matter; 2nd, certain poisonous compounds of metals, especially lead; 3rd, decomposing vegetable matter.

The great danger of excretal contamination of drinking water arises from the disease germs that these matters are liable to contain. A very large amount of the water used by civilised man is grossly contaminated in this way. The following are some of the common ways in which this horribly disgusting and desperately dangerous pollution of drinking water is brought about:—

(1) Sewers and drains discharging their contents into rivers and streams from which water is drawn for drinking purposes.
(2) Privy cesspits, leaky sewers, cesspools, pig-sties, manure heaps, etc., soaking constantly into one part of the soil, and their liquid filth joining the water under the ground; and this water being tapped by shallow wells (p. 72) from which drinking water is derived, or by the natural opening in the form of surface or land springs.
(3) Heavy manuring of cultivated lands fouling the surface waters, water courses, and land springs.
(4) Shipping, etc., in rivers discharging their refuse into the water.
(5) Uncovered wells, without coping, allowing foul matter or bodies of animals to flow or fall into the well.
(6) The channels, by which water is brought from its

sources to the consumer, having communication somewhere with other channels conveying sewage matter.

(7) Tanks, reservoirs, and other places where water is stored being contaminated by sewer gas, excretal matter, organic dust, etc.

The appearance and palatability of a water is not a proper guide to its fitness for drinking purposes. Many horribly polluted waters are clear, sparkling, and pleasant to the taste. Filtration through a few feet of some soils readily removes the visibly disagreeable properties of the most filthy liquids; such slight filtration does not, however, remove their dangerous properties.

The following are some of the forms of disease frequently caused or favoured by bad drinking water:—Typhoid fever, cholera, diarrhœa, constipation, diphtheria, indigestion, various forms of sore throat, general bad health and depression, boils, intestinal worms, and other diseases caused by the development of stages of worm life in other parts of the body (p. 118).

As a rule, the sources of water most free from excretal contamination are:

(1) Deep springs with their outlets carefully guarded against surface contamination.

(2) Deep wells—*i.e.* wells sunk into a deep layer of the ground cut off from the surface soil and formation by an impervious layer of rock, such as stiff clay. Deep wells must have their upper parts thoroughly lined, so as to make them impervious to water, and must be protected by good covers and surrounding coping.

(3) Surface water in streams and lakes from the high lands and mountain tops and other uninhabited and but slightly-cultivated lands.

A few further details about some of the above described sources of water are necessary.

Shallow and Deep Wells.—The descriptive words shallow and deep are not used to indicate the relative depths of wells, but to describe the water-bearing stratum they tap. In fig. 18 a shallow and a deep well are represented side by side. The shallow well G taps the underground water of the surface

stratum AB. This is represented as being contaminated by soakage from a cess-pit, manure heap, and sewer. The deep well passes through stratum AB, through an impermeable stratum BC, and taps the water in a deep permeable stratum D. In the diagram this stratum is represented as cropping up to form hills. This outcrop may be many miles from the spot where the water is tapped by a deep well. On account of the long distance rain falling on the hills has to percolate before it reaches the well, any organic impurities it may have

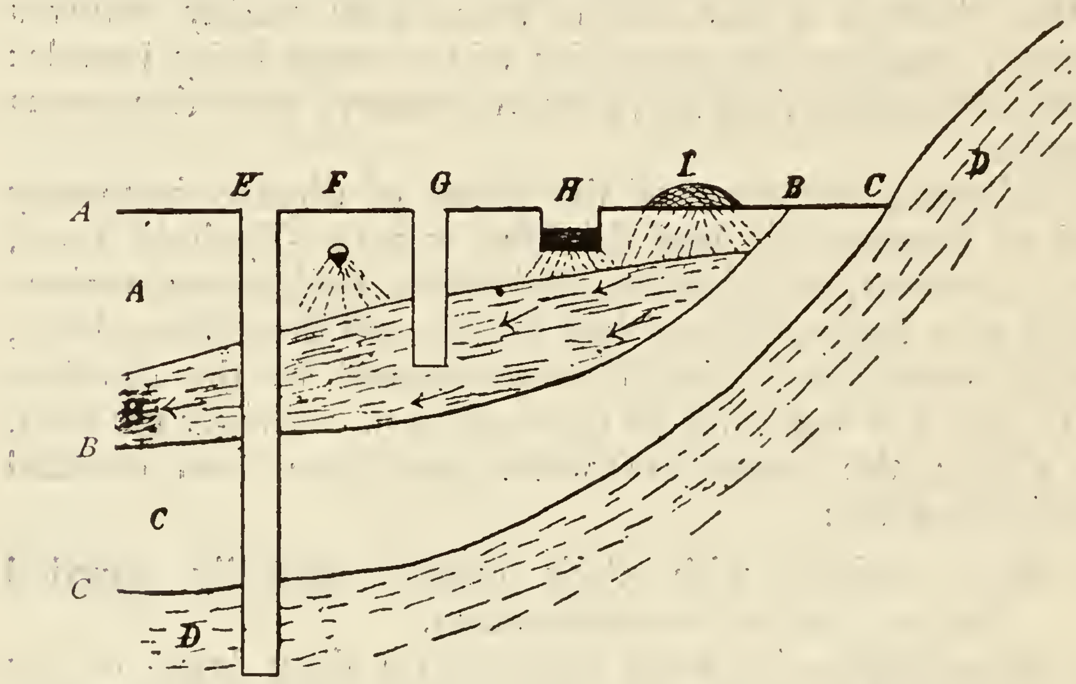

Fig. 18.—E = deep well. F = sewer. G = shallow well. H = cesspit. I = manure heap. AB = surface stratum. BC = impermeable stratum. D = deep water-bearing stratum, with outcrop in hills at right of diagram.

obtained from near the surface will have been removed or rendered innocuous. It is, however, manifest that surface water and the excreta-contaminated water of AB must be kept out of the deep well (p. 72). The horrible character of shallow well water, as used by most of the inhabitants of rural parts in our country, is graphically described in the sixth report of the River Pollution Commissioners :

"The common practice in villages, and even in many small towns, is to dispose of the sewage and to provide for the water supply of each cottage or pair of cottages upon the premises. In the little yard or garden attached to each tenement or pair of tenements, two holes are dug in the porous soil ; into

one of these, usually the shallower of the two, all the filthy liquids of the house are discharged; from the other, which is sunk below the water line of the porous stratum, the water for drinking and other domestic purposes is pumped. These two holes are not unfrequently within 12 feet of each other, and sometimes even closer. The contents of the filth hole or cesspool gradually soak away through the surrounding soil and mingle with the water below. As the contents of the water hole or well are pumped out they are immediately replenished from the surrounding disgusting mixture."

It is possible for people to drink such liquid horrors for years and yet in some cases get no more serious trouble than perhaps a little dyspepsia, an occasional sore throat, an outbreak of boils or festering of wounds, and similar slight ailments. By-and-by the special poison of severe and deadly disease finds its way into the well, and then disease breaks out.

The mere cleaning out of a badly-contaminated well is of little use, and will not prevent disease arising. The soil all round the well, through which the water has to pass, is probably soaked with the poisonous matter, and fresh water brings with it fresh supplies of organic matter and germs.

In the construction of wells the following points must be attended to:—

(1) Make the well as far as possible from any polluted area, and in such a position as to tap the underground water before it flows by or under any possible source of contamination. (Fig. 19 at A, not at B.)

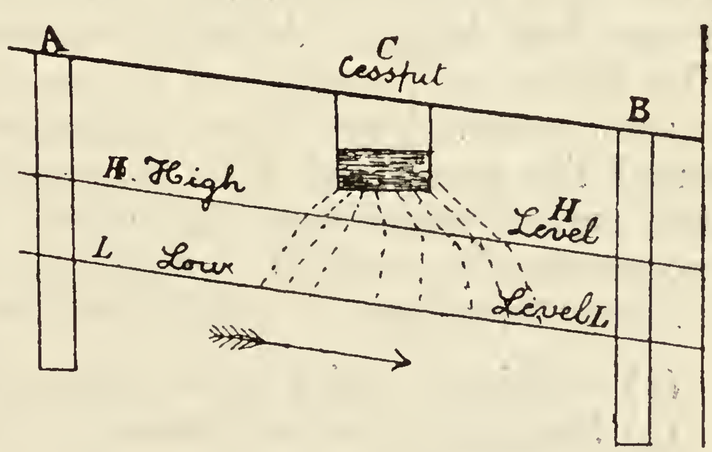

Fig. 19.—Section showing cesspit soakage and well-site. A = well situated above cesspit C. B = well situated below cesspit C. Arrow indicates direction of underground water-flow. Well B is more manifestly contaminated when underground water reaches its high-level H, than when it is at its low-level, because cesspit soakage has less soil to filter through.

(2) Puddled clay should thickly surround the upper part of a shallow well, and the bricks should be embedded in good impervious

cement. The same precautions must be taken throughout the upper porous stratum in a deep well.

(3) Top of well to be built up a little above the level of surrounding ground, and be covered with a good impervious cover.

In cases where the well is too deep for an ordinary suction pump, and the more expensive force pump is not used, it is very common to fit up over the well a windlass chain and bucket. In these cases the well is generally left uncovered, and becomes a death-trap in which stray cats, frogs, and other unfortunate animals find an untimely grave. Their rotten dead bodies are then gradually consumed with the water in which they have undergone decomposition. An easily movable cover should always be made for these wells, and, of course, it must not be thrown aside, but kept over the top of the well.

Abyssinian Tube Wells are often excellent substitutes for dug wells. They consist of iron tubes hammered into the ground until water is reached. The tube is driven down in lengths. The first length is closed below by a point, above which the tube is perforated by many holes; when this is hammered right down into the ground another piece is screwed on. Thus by repeated screwing on of pieces the tube is driven deeper and deeper. A pump is screwed on to the last piece. The first water pumped out is generally thick, the loose rock is soon removed, and then clear water is obtained. Soakage round the pump and tube sometimes loosens the soil, and then surface water may soak down. Care must be taken to protect the site round the pump from waste water.

Examples of ways in which wells are contaminated:

(1) Soaking cesspits, sewers, and drains (fig. 18, p. 70).

(2) Stoppage of drain, leading to leakage where pipe passes near well.

(3) Rats making a run between drain and well.

(4) Drain carried across well, and broken at crossing, and so discharging contents directly into well.

(5) Drainage and soakage from farmyards, pig-sties, cowsheds, etc. Absolute confidence cannot be placed in efficacy of any drain pipe, and so they must never be placed near a well.

(6) Well having asparagus beds, cucumber frame, and such like heavily-manured soil over or near it.
(7) Dung heaps, filthy ashpits, etc., near well.
(8) Wells without cover or coping, allowing surface water and animals to tumble into them.
(9) Area of well drainage increased by depression of water in well due to pumping (fig. 20, below), and the new area including a polluted site.

Fig. 19, p. 71, illustrates the contamination of well B from soaking cesspit. The arrow represents direction of flow of underground water. If well instead of being situated at B had been dug at A, it would have been above cesspit and perhaps not contaminated under ordinary conditions. A well may, however, be made to drain an area below it if the water

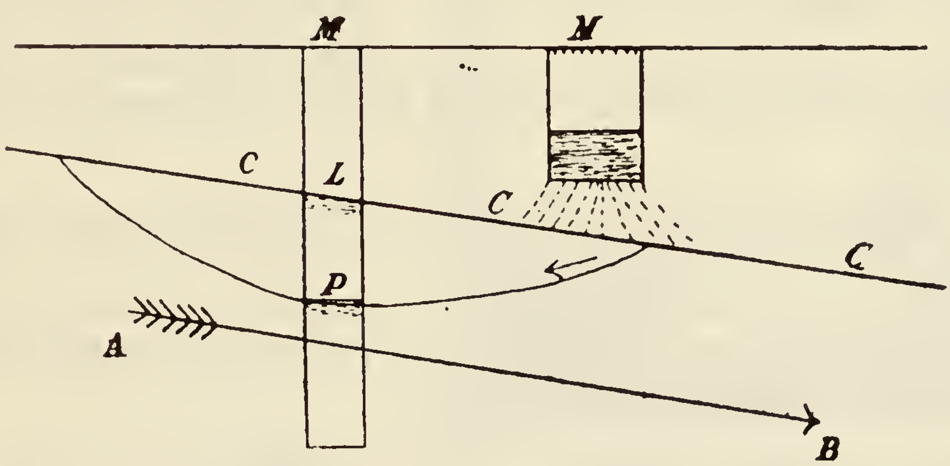

Fig. 20.

in the well is much depressed by pumping, etc. Fig. 20 illustrates this. AB indicates direction of flow of underground water. Ordinary level of water in well is represented by L. Under this condition the cesspit soakage flows away from well, but if the water is removed from well so that its level is lowered to P, water then flows into the well from an area all round as represented by the curved line, and this area includes the drainage from the cesspit situated below the well. The circle drained varies with porosity of rock, it is larger in very porous or fissured rocks.

Springs.—Springs are generally described as land and main springs. Land springs are often due to surface depressions touching the underground water level. Sometimes when the underground water reaches its low level such springs run dry.

Manifestly they receive water from very near the surface, and so are extremely liable to organic pollution. Main springs are from a main water-bearing stratum, they are usually perennial, but in most cases somewhat reduced in amount during the summer. Springs acting as the main outlet of a geological stratum do not necessarily, as sometimes stated, give a pure water.

Fig. 21.—C=cesspit contaminating spring S. S=spring, the outlet of underground water B of surface stratum AB. Arrow=direction of ground water flow.

Fig. 21 illustrates the spring outlet of a surface stratum contaminated by cesspool soakage. Even when a spring comes from a deep stratum, great care is necessary to investigate its immediate neighbourhood for surface-derived impurities. The following precautions should, therefore, always be taken when a spring is chosen for a water supply :—

(1) Investigate surroundings as to cesspits, manure heaps, drains, pig-sties, etc.
(2) Sink a pipe in the ground to conduct the water through surface layers to a moderate height above the soil.
(3) Fence around the spring site.

Upland Surface Waters.—The rain falling on the hills and running down in little streams and rivulets, forms the upland surface waters. Many towns obtain a good water from natural lakes, or by damming up a valley, and collecting this water in the reservoir so formed. Edinburgh is thus supplied by water from the Pentland Hills; Glasgow from Loch Katrine; Manchester from Thirlmere. This source of supply is generally a good one. There are but few people living in these highland districts, and the land usually poorly cultivated, and so the risk of sewage contamination is slight. Such waters in places contain a good deal of vegetable matter in form of peat. This in itself is not usually injurious, although it is not pleasant to the palate. If allowed to stand for long in reservoirs the peaty colour and taste diminish considerably. The great danger about peaty waters is, that certain organisms growing in peat form acids which act as solvents for lead. Lead pipes,

and, worse still, lead cisterns, are acted on, and lead poisoning results. Diarrhœa occasionally arises from water with great excess of peaty matter.

Stored Rain-Water.—This is not a good source of supply in this country, at all events in towns. The rain washes impurities out of the air. It also washes the roofs of the houses, from which it is collected. The droppings of birds and other filth are added, and the water thus made unfit for drinking purposes.

Rain water is frequently made more impure from the methods employed in its storage. Sometimes it is collected and stored in tanks underneath the house. This is always a bad system. Not unfrequently these tanks have a trapped or untrapped overflow pipe connected with the house drain. (Fig. 22.) The trap, when present, is in dry weather generally empty from evaporation, and thus a constant supply of drain air is laid on to the rain-water tank and basement of the house; at other times the drain is obstructed, and instead of the rain-water tank overflowing into the drain the drain overflows into the rain-water tank. Even when the rain-water is stored in water-butts above the ground foul matter is allowed to accumulate in it. Generally these butts are never washed out, and invariably a deposit of black organic mud, of a thickness depending upon the position of the tap, collects at the bottom. It is not uncommon in country farms to use the water for the domestic brew of beer drawn out of rain-water tubs that have certainly not been cleaned out for forty years or more. Such water is unfit even for bathing purposes.

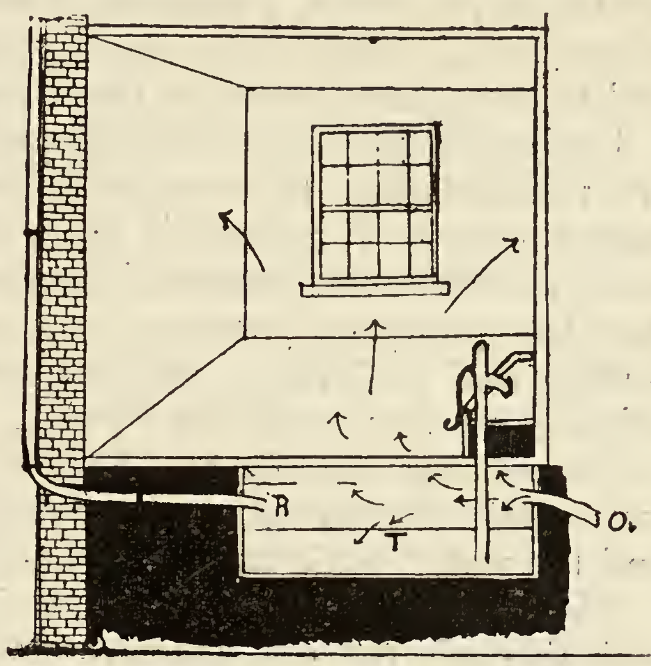

Fig. 22.—T = Rain water tank. Ov = overflow to drain. R = rain-water pipe. Arrow = sewer air.

River Water to which Sewage has Access.—In England such water is almost always dangerous, despite natural purifying processes.

Purifying oxidation processes go on actively in river water,

and if the stream has many falls and eddies the amount of oxygen dissolved in the water is so great that a moderate contamination would soon be got rid of. Moreover, there are various green river-plants continually at work giving out oxygen in a most active condition. The oxidation processes in rivers differ from those in the soil, but resemble those in atmosphere. They are not direct results of germ life. The chemical action is started by bright white light; yellow light not much use for this purpose, and so in a thick, muddy stream oxidation is checked or stopped. In addition to the oxidation processes, a number of fish, shell-fish, cray-fish, small animalculæ, microscopic plants, and bacteria live on sewage and other organic *debris* in the water.

Unfortunately, these purifying processes in most of our rivers are not sufficient to cope with the quantity of dead organic matter constantly poured in them from source to mouth. In many cases the foul matter discharged into the rivers is so great that the purifying processes are stopped altogether, and the sewage and foul trade effluents travel down them totally unaffected by any purifying change.

Proper settling-tanks and filter-beds can greatly improve river water. The organic matter and living germs are vastly diminished, and the water made far less dangerous but not absolutely safe.

Hardness of Water.—Water, and its dissolved gases, as they soak through the soil, dissolve various mineral matters. As a rule these mineral substances are not injurious to health. Most of them, however, give to the water a property known as hardness. Hardness is the power possessed by water of making an insoluble compound with soap. There are two classes of hardness known as *temporary* and *permanent.* The temporary hardness is caused by a compound known as bicarbonate of lime, and it is removed by boiling. The permanent hardness is due to the sulphates of lime and magnesia, and other salts. Waters containing a large amount of permanent hardness are liable to cause diarrhœa and digestive disturbance. Well and spring waters are generally very hard waters; rivers vary greatly according to their position; upland surface lake water, and rain water, are soft waters.

Whenever there is any reason to suspect a drinking water of being contaminated by excretal matter, either at its source or during storage or distribution, the water ought never to be

used for drinking purposes until it has been boiled for at least five minutes. This ought to be done systematically. A large jar or jug should be kept for the boiled water, and one of the first duties of the housewife on coming down in the morning, after drawing off water from the lead pipes for other purposes than drinking (see p. 163), should be the boiling of a large kettle of water to fill the jug used for drinking purposes. The so-called flat taste of boiled water is not liked at first, but a taste for it is soon acquired. The boiled water is made rather more pleasant to take by being filtered through a clean and regularly kept clean filter. A filter used for this purpose must never on any account be used for unboiled water; if it is, the boiled water may become contaminated with disease germs. If a filter is not kept for this purpose the boiled water may be improved in flavour by the simple expedient of pouring it from a height out of one jug into another. This plan, frequently used to improve flat beer, may be similarly applied to the flat boiled water.

Domestic filtration cannot be relied on as a means of purifying water, unless some form of porcelain material is used, and the water forced through it under pressure. Even in such cases the most extreme and delicate care must be taken, and in a way only possible by the hand of one trained in delicate bacteriological work. Excepting the above-mentioned kinds, all ordinary filters capable of being generally used for home purposes are practically useless as a means of removing the germs of disease from contaminated water. Boiling is the only reliable method. If a filter is used at all, the following requirements must be fulfilled. Every part must be easily cleansed.* The filtering media should be allowed to run dry occasionally so that fresh air may enter, it should be free from organic compounds, and should have a lasting action, which

* *Cleansing of filtering media.*—*Animal Charcoal*—(1) Heat to redness; (2) wash well with water; (3) boil in solution permanganate of potash 25 grains, strong pure hydrochloric acid 30 drops, water 1 quart; (4) wash well in several lots of water; (5) dry in sun. *Blocks of Charcoal*—(1) Brush surface well; (2) soak in acid-permanganate solution as above; (3) force air or water through in reverse way to filter; (4) wash well, and pass water through until no colour of permanganate left. Do the above every month, and brush block well every week. *Asbestos*—Heat to redness, and wash. *Sandstone*—Scrub, and boil in permanganate solution.

had better be fairly rapid. The filter and filtering medium must give no metallic contamination to the water; all lead and copper fittings should be avoided. It must be regularly cleaned.

The last-mentioned of the above conditions is often sadly neglected. Numerous old-fashioned filters, in which the filtering medium is completely and permanently enclosed, so that it is impossible to clean it, are still in existence. Such filters after months or years of use, only serve to render the water injurious. Bacterial processes of purification are impossible in the small amount of medium of the filter, which is frequently in a horrible condition, and it is when examined, sensibly to the sight and smell, a filthy, wriggling abomination. If any of my readers possess such an apparatus they should destroy it at once, not merely put it on one side and then by-and-by send it to a jumble sale so that others may buy and use it.

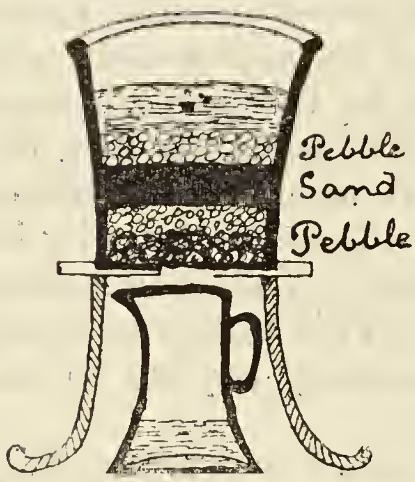

Fig. 23.

A simple flower-pot, with pebbles and sand in layers, will be found to form a filter suitable for all purposes of aeration; it is cheap and easily cleaned. (Fig. 23.)

PUBLIC WATER SUPPLY

The following list gives an idea of the daily amount required by each individual:—

PURPOSE.	GALLONS.
Drinking water	0·30
Cooking	0·70
Ablution (daily sponge bath of 2½ gall.)	5·00
Utensil and house-washing	3·00
Laundry	3·00
Water-closets	6·00
Weekly bath of 28 gallons	4·00
Unavoidable waste	3·00
Municipal purposes	5·00
Manufacturing purposes	5·00
Total	35·00

Water supply is either intermittent or constant. The latter is preferable, if all house-fittings and connections are of the right kind. The objections urged against the intermittent system—*i.e.* when the water is only turned on for a limited time at certain intervals—are:

(1) Evils arising from storage in large cisterns.
(2) Vacuum formed in mains by water leakage, so foul air, and perhaps sewage, is sucked into them.
(3) Admission of air into iron mains leads to rusting.
(4) Delay in case of fire.

House Cisterns may be contaminated, and the water made injurious in many ways—*e.g.* lead salts, sewage or sewer air, dust and dirt, dead animals.

MATERIAL FOR CISTERNS

Lead is a bad material for cisterns supplying drinking water to a house. If lead cisterns exist, care must be taken in cleaning them not to scrape off the dull surface. The best material for cisterns are (1) *Earthenware*—this has, however, the slight objection of being very heavy; (2) *Slate, with cement joints.* Joints must be well made, or are apt to leak; when leaking, they must not be repaired with lead compounds. (3) *Galvanised Iron.* Cheap, but wear out rather quickly. Injurious action has been said to arise from the zinc, but it is improbable.

CONNECTIONS OF CISTERNS WITH DRAINS

Sewage and Sewer Air contaminating Cistern.—Cisterns supplying water for drinking purposes must not be used directly for water-closets, urinals, or slop sinks. Small cisterns must be interposed for flushing all pipes and openings leading direct to the drainage system. (Fig. 24, p. 87.)

The overflow pipe from a cistern must be carried directly through the wall, and be cut off in the open air. In some old houses there still exist cistern overflows taken into soil or drain pipes—an arrangement hideous and dangerous in the extreme. In such cases traps in the overflow pipe are absolutely useless.

The main house cistern must not be placed in a water-closet.

SITE OF CISTERNS

Dust, Dirt, and Dead Animals in Cisterns.—All cisterns should be supplied with good and ventilated covers. They ought to be placed in positions easily got at for cleansing purposes—*e.g.* in attics, not in inaccessible places on roof. (Fig. 24.) Out-of-sight out-of-mind cisterns are often very dirty, even in houses of the most cleanly persons.

SIZE OF CISTERNS

Houses supplied by intermittent system often have cisterns too small to contain a full supply for the period of intermission. Cleanliness of persons, houses, and drains are, in consequence, neglected, to the sore distress of health and comfort.

Constant Service and House Cisterns.—General storage cisterns may be necessary, unless the arrangements for water supply are very perfect, and the supply itself very plentiful and regular in amount.

Small cisterns must be interposed between pipes from the main and opening for flushing drains—e.g. *closets, urinals, and slop sinks.*—If these places are supplied directly from the main the gravest results may occur during any accidental intermission of the service. In some cases, not only sewer air, but liquid filth, has been sucked out of water-closets into the water mains, spreading virulent epidemics of typhoid fever. Cisterns also should be supplied to slaughter-houses, etc.; bloody water has at times been sucked into the mains.

Street Water Mains should be laid in special trenches, as far as possible from the sewers and gas mains. Water pipes are never all perfect, and so leakage will occur, and during intermission of service become empty, and so air and liquids in the soil around may be sucked into the water main.

CHAPTER XIV

THE DISPOSAL OF REFUSE—DRY SYSTEMS

The guiding principles for the disposal of refuse are:

(1) No accumulation of waste organic matter, either animal or vegetable, should be allowed to exist in or near a dwelling any longer than is absolutely necessary.

(2) When it is necessary to retain such refuse about a dwelling, it should be kept as dry and cool as possible. Warmth and moisture favour putrefaction processes.

(3) Organic refuse should be oxidised, purified, and reconstructed into living matter by the soil and its vegetation. In order that this can be done, refuse must be widely distributed on the soil surface, and all areas of the soil must be allowed regular periods of rest, during which time no refuse is placed thereon.

Continued soakage of one area of the soil with wet viscid filth clogs up the pores of the soil, fresh air cannot enter, and the filth soaks down unpurified to poison the underground water (Chap. XI., pp. 56-57).

DUST BINS AND DUST BIN REFUSE.

Insanitary Dust Bins.—It is still, unfortunately, a not uncommon thing to find adjoining even urban houses a large brick lean-to structure, with a loose-fitting wood lid that is generally broken and thrown on one side, or anywhere rather than used in the place and for the object of its existence. The floor of this construction is generally porous and soaked with moisture, the walls are constructed of the worst sorts of porous bricks and mortar. This arrangement is rendered hideous by being generally three-quarters or so full of cinders, discarded food matter, with a large amount of moisture derived from wet tea leaves, cabbage water, rain water, and various other house waters, all more or less laden with putrescible organic matter. In this way a large accumulation of moist organic matter is allowed in the immediate neighbourhood of the dwelling; putrefactive processes are started therein, and so raise its temperature, and then stinking horrors

are rapidly produced. The water, percolating through the foul, reeking, and abominable mass, soaks into the ground, the porous brickwork, and walls of the house, and renders them also foul, reeking, and abominable. The occasional visits of the dustman result in a partial removal of the hateful mass, and a wholesale stirring up of filthy odours. The occupants of the house hold their noses for awhile, exclaim, "How nasty! How horrid!" perhaps put down a little chloride of lime, sanitas, or carbolic powder, and then rest content. The dustmen, with their foul and stinking load, proceed down the street, the fresh wind blows over their cartload of abominations, and then blows on, fresh no longer, but fœtid and, maybe, pestilential. The wayfarers in the track of the cart with a phew! of disgust hold their breath and hastily pass aside. But the cart jumbles and journeys on, receiving more and more foulness, and then is emptied on some municipal area, to foul the air around until a convenient time comes for it to be carted farther afield, or, as in the bad old days, removed by a speculative builder to form the foundations of a desirable suburban villa.

SANITARY DUST BINS

Such an arrangement as the above, or the equally obnoxious large dust *pit*, are absolutely unnecessary in any place. Where a sewerage system exists the following requirements of dust-bin refuse should be fulfilled. The dust-bin to consist of a galvanised moveable iron box; water-tight lid kept closed; no liquids to be thrown in; to be emptied at least twice weekly; food and organic refuse to be burned before putting it in bin, unless used in gardens, or for feeding animals. The burning is fairly easily accomplished by the kitchen fire last thing at night. Towns insisting on the above should supply carts to remove straw and such refuse, and perhaps charge a *small* sum for its removal. Nuisances might often be so prevented.

EXCRETAL AND SEWER REFUSE

Dry System.—Middens—Pails—Dry Earth Closets.
Water-Carriage System.—Sewerage—Cesspool.

The dry system of disposal should enable the solid fœcal matter to be kept in as dry a state as possible. The slop waters should be disposed of separately.

Water-Carriage System makes use of a flush of water to remove the excretal matters at once down a system of pipes from the neighbourhood of the dwelling. The water-carriage system properly carried out in towns is safer, less offensive, less expensive (excepting where water is very scarce), and more convenient than the dry system.

In towns adopting the dry system, drains and sewers are necessary. These drains and sewers convey the bedroom slops, dirty bath and lavatory water, the drainage of stables, cowsheds, urinals, and slaughter-houses; they therefore contain a lot of poisonous filth, and sewer gas is generated in them, so that they require as careful construction, ventilation, etc., as the drains and sewers of towns adopting the water-carriage system. Moreover, nearly equal care must be paid to the purification of the sewage of each system before it can be discharged into a stream. In the dry system there is, therefore, the extra expense of the removal of the solid excreta, which, as manure, do not pay the cost of safe removal and preparation. In towns, in which it is difficult or impossible without extreme expense, to get an efficient water supply, it may be cheaper to adopt the dry system.

In scattered rural districts some form of the dry system must be adopted.

Details re *Dry System.*—Old-fashioned privy middens, with a big, wet, soaking cesspool pit, are an offensive nuisance, and a grave danger to health. They poison the air and water, and they foul the earth. The privy midden, with fixed receptacle for fœces and ashes, is, on the whole, an undesirable arrangement, yet it is possible to avoid the greatest nuisances that arise from them if the following requirements are fulfilled:—

Size of Receptacle.—Eight cubic feet is limit in large villages. This necessitates a weekly removal of contents. One cubic yard should not be exceeded for scattered cottages. This necessitates removal of contents every three months.

Sides and floor of receptacle must be made smooth and impervious to moisture. The floor of receptacle must be above the ground level. The receptacle should be protected altogether from the rainfall. The opening into the receptacle for ashes may conveniently be outside behind the closet, and the lid should be made self-closing. A shoot may be arranged so

as to direct the ashes to cover the excretal matter. It is also advisable to have a box of sifted ashes and shovel inside the closet, so that the excrement may be covered and dried each time the closet is used.

The floor of the closet building should be made impervious, and sloped towards the door.

The closet should be well ventilated. Whenever the closet is placed near the house or well it is undoubtedly better to avoid the midden with a fixed receptacle, and adopt the pail or dry earth closet.

Pail Closet.—A bricked and cemented space is left under seat of closet and three inches above level of ground. In this a galvanised iron or tarred oak pail is placed. The capacity of pail should not exceed two cubic feet.

In towns and villages where pails are removed and emptied by scavengers, air-tight lids must be supplied with pails.

A box of sifted ashes, dry earth, or charcoal, should be kept in the closet, and a little shovelled in the pail every time it is used. Slops and waste waters should be kept out of the pail. Where there is no system of top soil drainage, sub-soil irrigation, or public drainage, these waste waters have to be poured over the garden. Different areas of the soil should be chosen for each day's emptying, and part of the garden as far as possible from the well used. The closet pail requires to be emptied weekly. Its contents must go to the soil. They should be buried just under the surface, and as widely distributed as possible in those parts of the garden farthest from the house and the well.

The conversion of an old privy midden, with wet soaking cesspit, into a pail closet need not be a very expensive matter as a rule. The pit must be thoroughly cleaned out, and filled with pure earth and well beaten down. This must then be paved. The space under the seat of the old closet should be paved and cemented, the closet seat hinged, and the pail put under it.

Earth Closets are preferable to the above when they can be properly attended to. They are better when a mechanical means is supplied to place required amount of earth on the excreta each time they are used. A box behind is filled with earth, and handle to raise, and the raising of handle throws

into receptacle the required amount of earth. The earth must be well dried, brick earth and loamy surface soils act admirably. Sand and gravel are not suitable. Liquids are not to be thrown into the closet. The fœcal matter and paper are disintegrated, and the mass when dried may be used again. It has little manurial value.

DRY TREATMENT OF URINE BY DR POORE'S METHOD

Country Houses and Cottages.—Inexpensive and non-offensive urinals can be constructed of a barrel of deal sawdust. This has power of absorbing and removing all bad smelling property of urine in very large amounts. In public places, cricket grounds, country railway stations, etc., troughs of perforated zinc of triangular section, with apex downward, filled with sawdust, act admirably. The liquid that filters through is free from all offensive properties, and the air of the urinal is far fresher and purer than those with ordinary water flush. When constantly used, the sawdust must be turned over and stirred occasionally. The urine-soaked sawdust forms when removed —and this removal is not a frequent necessity—an excellent top dressing for agricultural purposes, none of the supposed ill-results of sawdust manure arise from its use.

CHAPTER XV

WATER-CARRIAGE SYSTEM

When deposits of fœcal matter are allowed to exist in a drainage system offensive gases are evolved and mix with air of drains. Deposits dry on the upper part of drain and form dusty material if much splashing occurs or the level of water in pipe varies; in this way germs, and often germs of disease, get mixed with the sewer gas. Sewers and drains must be properly ventilated, or sewer gas will force its way out at inconvenient and dangerous places. A good drainage system leads to a minimum amount of sewer gas being formed. Sewer gas is, of course, formed in cesspools as well as in sewers, and

houses connected by drains with cesspools are more likely to get sewer gas than those connected with sewers.

SOME OF THE EVILS FROM SEWER AIR IN HOUSE	Frequent small doses may cause	Anæmia. Loss of appetite. Prostration. Diarrhœa. Fever. Headache in the morning. Vomiting. Sore throat.
	Large doses may cause	Sudden and violent vomiting. Purging. Violent headache. Extreme prostration, or death.
	Specific germs in sewer gas cause	Typhoid, scarlet, and typhus fevers, cholera. Puerperal fever, and other blood poisonings. Acute tonsilitis. Diphtheria and erysipelas, etc. etc.

The evils of sewer gas can be prevented by a good arrangement of ventilated, trapped, and well-looked-after drains.

Cesspool Drainage.—Cesspools, even when properly constructed, should not be within 50 feet from the house or 80 feet from a well, spring, or stream used for drinking or domestic purposes.

Cesspools are to be avoided when possible. When used, they ought to be made water-tight, no overflow into a stream or village drain is allowable. They must be well ventilated, and had better be fitted with a chain pump, and a large hermetically-closed manhole built in for sake of cleaning out cesspool at regular intervals.

HOUSE DRAINAGE NOMENCLATURE

Soil Pipe = Pipe above ground which receives drainage from water-closets, slop sinks, and urinals. (Fig. 24.) It ought not to receive any other drainage.

Drain Pipes = Pipes under ground receiving directly the soil pipe drainage, and, through intervention of trapped gullies and branch drains, other liquids from house.

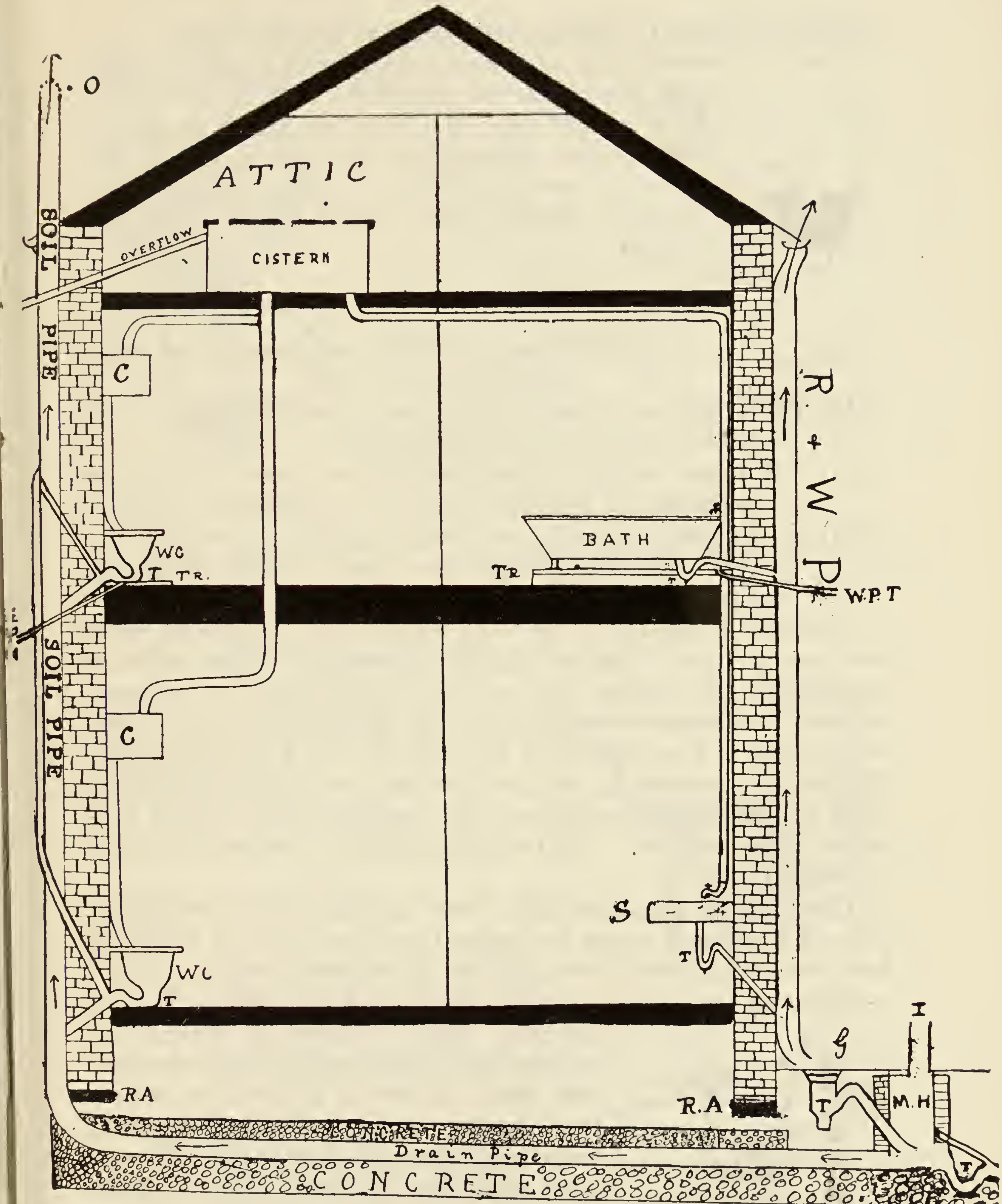

Fig. 24.—Diagram of house drainage; cistern placed in attic, not inaccessible place in roof, and supplied with ventilated cover and overflow pipe to outside. C C=small cisterns for water-closet flushing. W C=water-closet. T=trap. TR=save-all tray. W P T=wash-pipe from tray. R and W P= rain and waste-pipe from bath and kitchen sink. S=sink. G=trapped gulley. M H=inspection chamber. I=inlet of fresh air to drain. O=outlet (upper end of soil pipe). R A=relieving arch at point where house drain passes under house wall. Arrows indicate direction of air current in drain, soil, and waste pipes.

Sewers = Pipes receiving drainage from several houses.

Traps = Contrivances to prevent air from one part of drain pipe from entering another. Fig. 25 is a trap. It is a bent pipe, the bend of which is full of water (dark shading). The water seal is the depth of water between level of upper curve of trap and the highest water level (dotted line in fig.).

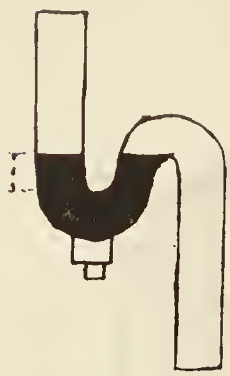

Fig. 25.

CONDITIONS NECESSARY FOR SAFETY

(1) Air from common sewer must not enter house drains.

(2) Air from house drains, soil pipes, baths, lavatory, or sink waste pipes must not enter house.

(3) All pipes, traps, gullies, and gutters must be kept as clean and as free from deposits as possible.

(4) A current of fresh air should as far as possible be kept passing through the house drains and soil pipes.

The first condition is of vital importance. Typhoid fever and many other disease-causing germs pass from infected houses into the sewers, and so their contained air, if allowed to pass into house drains, may bring disease from one house to another. The condition is fulfilled, 1st, By limiting production of sewer gas (p. 86) and having sewers well ventilated; 2nd, By proper intercepting trap between house drain and sewer. (See fig. 26.) HD = house drain. A = fresh air inlet to house drain.

The trap is the bent pipe that is kept full of water, W. Pipe of trap must never be larger than house drain; it should have water seal (see above, fig. 25) of at least 3 inches. (*N.B.*—Water of trap acts as barrier to air on sewer side.) B is an opening, kept hermetically sealed, for use in case of obstruction between sewer and trap. Below is a stand to ensure trap being placed upright. Opening from trap to sewer S must be at lower level than that of house drain to trap, or liquid will be stagnant in house drain. Inlet opening A outside house is at ground level, or little above it, and must be equal to sectional area of drain

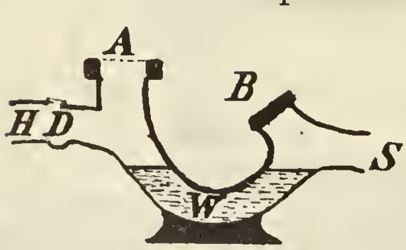

Fig. 26.—Intercepting trap.

pipe. A ventilated manhole chamber is with advantage placed on house side of trap. (Fig. 27.)

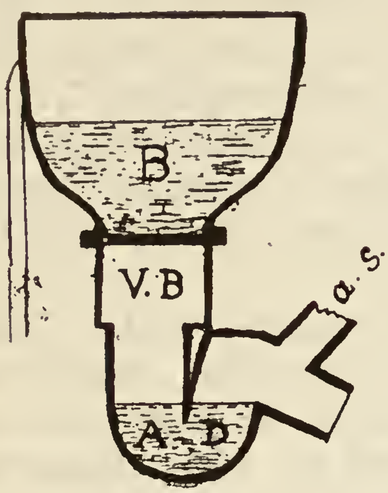

Fig. 27.—Valve Closet. B = basin. VB = valve box. A D = anti-D trap. AS = anti-syphonage opening.

The following description illustrates ways to fulfil the other conditions :—

Best Positions for Water-Closet.—In out-house, or as a projection from building, with cross ventilation in a short passage between it and the house. Water-closets should have large windows, so as to light the closet thoroughly. The window must be made to open. The swing-back pattern is excellent.

Bad forms of Water-Closet:

(1) The pan closet with container and D trap. (Fig. 30, p. 90.)

(2) The wash-out closet. (Fig. 28.)

(3) The long hopper closet. (Fig. 29.)

Forms of Closets that are only good when of the best possible workmanship and so expensive :

(1) The plug closet.

(2) The valve closet. (Fig. 27.)

Good Closets which can be made cheaply :

(1) Short hopper closet, with straight back, fitted with a 4-in. S trap, and with $2\frac{1}{2}$-in. water seal. The closet should have a circular flushing rim.

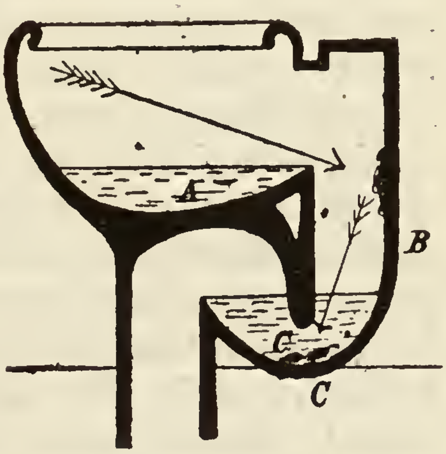

Fig. 28.—Wash-out closet. A = water in shallow basin, in which forces fall. Arrow = direction of flush. B = point where flush is broken and deposits occur. C = trap with deposits.

(2) Any of the other forms of wash-down closet in which the excreta fall directly into the water of the trap, and with trap and flushing arrangements that allow of perfect flushing of the trap. (Fig. 31.)

The water supply for water-closets must always be from a

special cistern used for the closet and for the closet only. For all closets, excepting the valve closet, a small water waste preventing cistern should be fixed. These work by syphon action, and are so arranged that a single pull of the chain starts the syphon action, and this continues until the cistern is emptied. These little cisterns should never be of smaller capacity than two gallons, and where the water supply allows it, a three gallon cistern had better be fixed. (Fig. 24.)

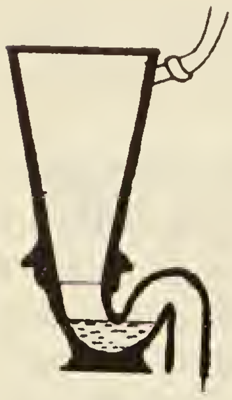

Fig. 29.—Long hopper. Flush loses power thereby round basin and deposits fur.

All closets must have proper traps. The anti-D, or other traps of this kind, should be chosen. The most common form of bad or dangerous trap found fixed to water-closets is the D trap. In houses where several closets, one above the other, open into a soil pipe, the traps should be provided with anti-syphonage pipes. (Fig. 24.) These are pipes leading from the drain side of trap and carried up to the top to open in soil pipe above highest closet.

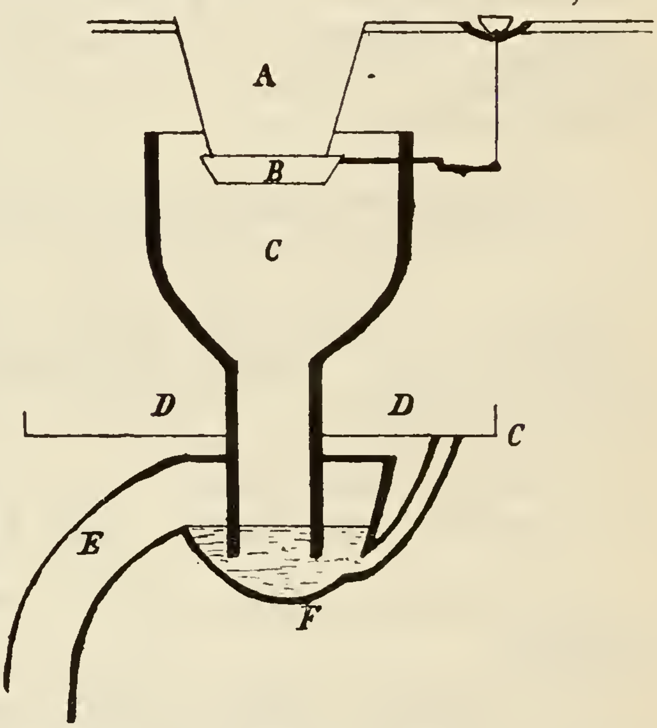

Fig. 30.—Pan closet. A=basin. B=pan. C=container always filthy. D=Save-all tray. F=D trap. C=Overflow. E=Unventilated soil-pipe.

Explanation of Syphonage of Traps.—If a large flush of water pass down a pipe so as to completely fill it (*e.g.* when valve closet is flushed, and the valve closed directly after the water has rushed from basin, or when a large bucket of slops is thrown down slop sink or closet) the air is driven out of the pipe before the descending water, and a vacuum formed. Air rushes in to fill up the vacuum and may enter by any opening into the pipe. If the opening is trapped, the inrushing air forces the water out of the trap before it; but if anti-syphonage

Fig. 31.—Wash down.

pipes are fixed, air rushes down them and the traps are saved.

Save-all trays are often placed under closets. The overflow pipe from there must never on any account be taken into the soil pipe or drain: it must always be taken through the wall and open directly outside. (Fig. 24.)

Water-closets, and all trapped openings into drain, must be regularly used. Some people think it better not to use an upstairs closet if possible to avoid it. Evaporation gradually diminishes water in trap, and eventually it dries up, and a free opening for drain air into house is allowed to exist.

The soil pipe must not be fixed inside the house, but always against the wall outside (fig. 24); if possible, it should not be exposed to the direct rays of the sun. Soil pipes must be made either of drawn lead or of thick iron, coated inside by some preservative solution. The joints of iron soil pipes ought to be well made and lead-caulked. The soil pipe must be carried with full bore, and, when possible, without bends, up above the eaves of the roof, and the end should be left perfectly open and be at least three or four feet from any window, and six feet from the opening of any chimney. (Fig. 24.)

Cowls fixed to the top of soil pipes are unnecessary; they may be capped by a small wire cage to prevent birds building in them. Rain-water pipes from the eaves gutters should always be entirely separate from the soil pipe or drain ventilator. (Fig. 24.) Below the ground level, the soil pipe must be joined to the house drain by means of an easy curve, and without any intervening trap. (Fig. 24.)

House drains should be made of circular-glazed socketed earthenware pipes. The sockets of the pipes must point towards the direction of the drainage flow. The pipes must be laid with a regular and even fall of 1 in 40 for a 4-in. pipe, and 1 in 60 for a 6-in. pipe. They must be laid on an absolutely firm rock or on a bed of concrete. When carried under the basement of the house (this is to be avoided if possible) they must be entirely surrounded with six inches of cement concrete. (Fig. 24.) Relieving arches should be built in house walls at places where drain pipes pass under them (fig. 24), otherwise slight settlement of house foundation may fracture pipes.

The joints of the pipe must be made with good cement.

All junctions must be made obliquely, right angle junctions are not allowable. Junctions between larger drain pipes and smaller ones must always be made with proper diminishing pipes.

No pipes from the house, excepting the soil pipe, ought to go directly into the drain. The only connections allowable with the soil pipe are water-closets, slop sinks, and urinals, and these must all be provided with traps on the house side of the soil pipe. (Fig. 24.)

Rain-water pipes, waste pipes from lavatories, bath, and sinks, other than slop sinks, must be cut off in the open, outside, and discharge their contents into a gutter leading to a trapped gully, from which a branch drain goes to join the house drain. (Fig. 24, p. 87.) Sinks, lavatory basins, and baths should all be provided with deep S lead traps on their waste pipes; the bottom of the dip of these traps should be supplied with a screw that can be removed in order to clean out the trap, in case of it being blocked at any time. (Fig. 25, p. 88.)

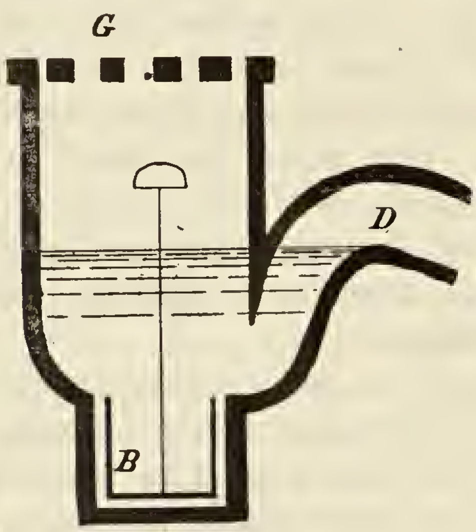

Fig. 32.—Trapped gully. G=grating. D=pipe. B=removable bucket to remove out deposits.

Gullies and sinks must not be trapped by such contrivances known as Bell traps, Antill traps, Dipstone traps. Fig. 32 shows suitable gully trap.

Gullies, whether trapped or not, must on no account whatever be placed inside the house or cellars.

The following *resumé* in tabular form may be useful to bring some of the above details together:—

Necessary sites for Traps.	(1) Between W.-C.'s, urinals, slop sinks, and the soil pipe. (2) Between baths, lavatories, sinks, and their waste pipes. (3) Trapped gully between waste pipes and drain. (4) Intercepting trap between lower ventilation opening of drain pipe and sewer.

Necessary ventilating openings.	Top end of soil pipe high up (outlet). Anti-syphonage from soil pipe end of closet traps. Bath waste pipe—both ends. (Fig. 24.) Lower end of drain pipe just before the intercepting trap between it and sewer (inlet for fresh air).
To be cut off outdoors above trapped gully.	Bath, lavatory, and sink waste pipes. Rain water pipe.

TREATMENT AND ULTIMATE DISPOSAL OF LARGE QUANTITIES OF SEWAGE

Dangers of sewage pollution of rivers are described in Chapter XIII. In inland towns sewage must find its way into water courses. This necessitates preliminary treatment of such sewage. The great number of processes may be classed into two great systems. In one the sewage is used to irrigate large areas of land, and by means of organisms in soil and vegetation cultivated on the land the effluent is so purified that it can be discharged into a river. The other process firstly aims at the removal of solid matter (*a*) by chemical precipitants; (*b*) by micro-organisms chemically altering solids so that it can be dissolved in water; and, secondly, by chemical processes oxidising the soluble organic matter in the remaining liquid—generally done by earth or more artificial filters, or by allowing it to flow over weirs, and so freely exposing liquid to air and light.

The first system.—Sewage farming or broad irrigation.—A large amount of land is required, and if this can be obtained at a moderate price, this method is perhaps the most economical way of treating sewage. Loamy soils are good for this purpose; gravel, sandy soils are usable with care; stiff clay is better when mixed with ashes or sand. The amount of land required varies with character of soil, and whether any precipitation processes are used. The usual figures given are 1 acre to 100 of population. A thin layer of clay over fissured chalk is unsafe. The clay cracks, and unfiltered sewage may pass directly into chalk fissure, the water in which is perhaps used for drinking purposes. There are various plans whereby the sewage is distributed over the farm—*e.g.* ridges and furrows are made; the ridges have

open carriers made in them, and then by temporary sluices sewage flows down slopes as required. Careful rotation of crops is advisable, and the land should have regular intermissions of sewage supply. When land is plentiful it is well to give parts long intermissions, and grow cereal crops, etc., the while. Sewage should be delivered at the farm as fresh as possible, and the coarser matter screened off. When the land is at all limited, artificial drained filter beds are required to purify sewage in wet weather and when the land is unable to bear it all. Properly conducted sewage farms need be no nuisance or danger to health.

Intermediate between the above system and the second is a process known as "intermittent downward filtration" of crude sewage. At least an acre of land is required per 1000 population. A porous loamy soil is most suitable. The land is carefully levelled, laid out in plots and underdrained with special care. The sewage is turned on to each plot for six hours, and then eighteen hours intermission is allowed for fresh oxygen to enter the soil. The plots are generally planted with rapidly growing plants.

The second system is carried out in the following ways :—

(*a*) *Precipitation methods*: (1) sewage screened to remove large masses; (2) sewage mixed with precipitants. Chemicals are used which cause a flocculent precipitate to form, which carries down most of the suspended solid matter. The sewage with its flocculent precipitate is allowed to stand for a time in tanks, the deposit settles, and the surface water is drawn off as effluent. The deposit or sludge is removed, compressed, and used for manure; in some processes, dried and powdered, it forms a useful manure, but generally its value is not great. (3) The effluent may be filtered through special beds of coke breeze, small coal, polarite, etc., or through the ground, as in the above-described intermittent downward filtration. The amount of land required for effluent after precipitation averages 1 acre to 5000 population. In some very complete precipitation processes the oxidation of effluent may be carried out by allowing it to flow over weirs, etc.

(*b*) *More complete Biological treatment of Sewage.*—During the last few years endeavour has been successfully made to get rid of suspended matters by bacterial action. In Exeter what is known as the septic tank has been introduced. A large

underground tank receives the crude sewage, which remains for some time therein. Bacterial action takes place, and the solid matter is digested by the organisms, and dissolves in the liquid. The liquid is removed and passed over an aerating weir into filters of fine clinkers. When one filter is full the liquid passes, by an automatic arrangement, into another, and when the second becomes full the first is allowed to discharge its contents, and the sewage from tank then passes into a third filter; and so on. Each filter takes about six hours to fill; it remains full six hours; it is emptied in less than an hour, and stands empty about eleven hours. Large numbers of oxidising organisms are present in the filters, and a supply of oxygen, and oxidation of the solution goes on very rapidly. This is one of the cheapest and most effectual methods of purifying sewage where broad irrigation is not possible.

CHAPTER XVI

NATURAL HISTORY OF SOME PREVENTABLE DISEASES

THE COMMUNICABLE DISEASES

MANY diseases are given from one individual to another, and some are transmitted from the lower animals to man. In these cases the poison, passing from the body of the sick to the healthy, is generally a minute living germ.

The poison leaves the body by one or more channels; these vary in different diseases:

(1) *Mouth and Nose.* — *e.g.* microscopic particles in breath; expectorated matter; nasal mucus and discharges; deposits from tongue, teeth, etc.; throat discharges.
(2) *Eyes.*—Discharge.
(3) *Skin Surface.*—Microscopic particles rubbed off surface, scabs and scales; watery, bloody and mattery discharges.
(4) *Bowels.*—Fœces and discharges.

(5) *Kidneys and Urinary Passage.*—Urine and discharges.
(6) *Abscess Matter*, and similar morbid collections from various parts of body.

The number of germs taken into the body when infected by a disease is generally quite sufficient to do harm; they have to breed in the body, and make as they breed a special poison, and this produces the symptoms of the disease. Sometimes the structures of the body are strong enough to kill the invading germs, or develop antidotes to these poisons, and no disease arises. If the germs are strong enough to multiply and overcome the body, the period of time that elapses between the entrance of the germs and the starting of the first symptoms of the disease is called the *period of incubation.*

There are many ways by which we may prevent communicable diseases from spreading:

(1) Destroy poison directly it leaves the body of patient.
(2) Stop poison from getting into streams, whereby it is spread around—*e.g.* air, water, soil; articles used in sickroom; bodies and clothing of visitors; corpse of patient; food.
(3) When poison is already in a spreading stream, destroy the poison in the stream, or else destroy or remove the stream.
(4) Prepare the bodies of those in reach of infection to resist the germs.
(5) Legal enactments.

FIRST METHOD

Try and destroy poison as it leaves the body of patient.

All stuff that the patient coughs or spits up—the urine, the bowel discharges, and vomited matters, and other infective matter—should at once be received into vessels containing enough disinfecting solution to completely cover them up. They must be thoroughly mixed with the solution, and allowed to remain in it for an hour before being buried in the soil or otherwise destroyed. One of the following disinfecting solutions should be used:—

POISON	Fairly pure carbolic acid (that sold as No. 5 carbolic) .	4 tablespoonfuls.
	Water . . .	1 quart.

Poison	Corrosive sublimate ...	$\frac{1}{2}$ oz.
	Spirit of salts	1 oz. fluid.
	Aniline blue	10 grains.
	Water	3 gallons.

The second of these solutions must not be metal in kept vessels, as it corrodes them. Both are powerful poisons. Instead of chemical disinfectants heat may be used with advantage. If a semi-liquid matter like expectoration or pus is to be burnt it should be received in a vessel with sawdust and paraffin in it. After the expectorated matter is in the vessel, more sawdust should be added, and the whole stirred up with a bit of firewood, and then the vessel emptied over a good, glowing fire, its contents and the firewood stirrer carefully burned, and then the vessel itself disinfected with the strong carbolic acid solution. This method is more certain if carefully carried out.

Great care must be taken to destroy all pus (mattery discharge). It is always laden with millions of germs. It should be burnt at once. Rags, dressings, poultices, etc., soiled by such matter, must immediately be put in the fire of the sick-room and carefully destroyed. Valuable clothing, soiled by these or other discharges from the patient, should be put at once into the carbolic disinfecting solution, and allowed to soak therein, and afterwards, if the material allows of it, should be boiled.

The secretions of the mouth generally contain the poison, and so all spoons, forks, cups, dishes, etc., should immediately be placed in the carbolic after the patient has used them, and must not be removed from the room *unless they are lying in solution.* Strict attention to this rule will prevent many unfortunate mistakes and sad catastrophes.

Discharges from the respiratory passages are invariably laden with disease germs. Handkerchiefs should, in disease, be replaced by old and comparatively worthless pieces of rag, and these, when used, should be burnt. When handkerchiefs are used they should be frequently changed, and the used ones immediately placed in the carbolic solution, and afterwards boiled.

The infectious matter leaving by the mouth and breath is often from accumulated fur and scum collecting on gums, teeth,

tongue, etc. Careful washing of patient's mouth, followed by disinfection of used mouth-wash and the burning of used rags. etc., will effectually destroy a large amount of infectious matter.

The so-called gaseous, but really fine particulate, poisons of the breath, the skin, and dusty matter in the air, are often, but not always, disinfected by plenty of fresh air being admitted into the sick-room. On this account a fire should be kept burning in the room, and the windows, or other inlets of fresh air, kept open. In some diseases, *under the direction of the doctor attending the case, substances like sulphur may be burnt in the room*; this method is very uncertain, and in many cases is injurious to the patient.

The skin may be treated in some cases by baths and ointments to destroy the poison given off by it, but this also must only be done under supervision of the doctor attending the case.

SECOND METHOD OF PREVENTION

Prevent access of poison to streams whereby it is spread about.

If it were possible to completely destroy all poison directly it leaves the body of patient no further discussion would be necessary; but, unfortunately, it is not entirely possible, so other precautions are necessary. In order to command as well as possible the various streams spreading the poison it is necessary to effect

Isolation of Patients.—Whenever a district has an isolation hospital, with proper ambulance arrangements, the patient should be removed from home to the hospital. When the patient has to be kept at home the following considerations must be attended to:—

(1) *Choice of Sick-Room.*—A room must be chosen at top of house, and, if possible, the whole upper storey of the house devoted entirely to the patients and attendants. The patient's room must have a fireplace in it, and be as large, light, and airy as possible. A floor without cracks between the boards is most important. The window should overlook a clear open space.

(2) *Preparation of Sick-Room.*—All unnecessary articles of furniture must be removed. Curtains, pictures, and all loose ornaments and hangings are not allowable. If a good smooth floor without cracks exists, carpets should be taken up. If the

floor is a bad one, it should be kept covered. A good fire must be kept burning in the room. Ventilating openings from outside must be allowed. The door leading to the sick-room should be protected outside by a sheet hung in front of it from top to floor. This sheet must be kept wet with a solution of carbolic acid, about quarter the strength of the formula given on page 96. If a whole storey or passage is isolated, a second sheet may be hung at top of staircase or entrance to passage if the house is so constructed as to allow it.

The bed should be as simple as possible. A small iron bedstead, with a woven spring mattress and thin horsehair bed, is the best.

(3) *Management of Sick-Room.*—Visitors to the patient must put on some general overall—of mackintosh, if possible—on entering room, and take it off on leaving. The hands, hair, and face had also better be washed before the visitor to an infectious sick-bed mixes with other people. Further, before closely associating with susceptible people, especially with children, he should take a good sharp walk in the open air, and, when possible, in bright sunlight, out in country or by sea.

All clothing material (bed-clothes, night-clothes, etc.), all utensils, should be soaked in 1 in 20 carbolic before they are removed from the room, and they must be taken out in such solution.

Mothers and others attending on child patients must avoid fondling them.

A special set of spoons, etc., should be kept for patients' use, and should be disinfected and washed in the room.

All books, cards, papers, etc., used in the sick-room must be destroyed when done with.

Letters must on no account be written in the sick-room, even if intended for adults or unsusceptible persons; such letters may infect others in the post.

A good fire must always be kept burning.

All precautions described under *Method I.* to be conscientiously carried out.

(4) *General Precautions.*—Children living in the house where a patient is suffering from communicable disease must not attend school, or mix with other children. This rule must be kept, despite the most elaborate precautions for isolation

of the patient, and it must be kept *until the full period of incubation of the disease has passed*, after the patient has gone or recovered, and the house been disinfected.

In cases where infectious disease has broken out in shops, factories, and other places, where food, clothing, and other articles are prepared, stored, or distributed, it is always advisable to remove the case at once, and see to immediate and thorough disinfection of the premises. Until this is done, the business must be stopped. No such business should be worked by anyone coming from an infected house.

After death from communicable disease, such as smallpox, the body should be buried as soon as possible. It should immediately be wrapped in a sheet soaked in a disinfectant, put in the coffin, which should then be immediately closed.

After recovery, or death and burial, of a patient suffering from a communicable disease, the room and house must be disinfected, and a free circulation of fresh air allowed. In all such cases the advice and assistance of the medical officer of health, or his inspector of nuisances, should be obtained, and it is well when the sanitary authorities undertake the disinfection of the house, bedding, and other articles.

Disinfection of Sick-Room (*vide* Disinfectants, Chap. I. p. 1).—All bedding and bed-clothes, hangings, carpets, etc., of sick-room, patient's and nurses' clothing, etc., should be sent to a disinfecting station in properly constructed conveyances, and disinfected by steam. If this is impossible, all that can be boiled should be so treated, the rest hung on lines and arranged about room. All cracks round windows, etc., to be papered over, chimney shut up, and then sulphur burnt in room—1½ lb. per 1000 cubic feet—or formic aldehyde forced through keyhole into room by special apparatus. (Sulphur may be used as sulphur candles or as liquified sulphurous acid, or by burning lumps of brimstone wetted with methylated spirit in iron dish placed on iron tongs, etc., over tub of water.) The room must be kept shut up for about twelve hours, and then all ventilating openings opened and kept so for twenty-four hours; paper then to be stripped off walls, floor and furniture swabbed with disinfecting solution, ceiling limewashed, and better if walls also done. Bedding to be taken out in open and freely exposed to bright sunlight and fresh air. Such is a brief outline of process; other details have to be attended to, according to circumstances.

THIRD METHOD OF PREVENTION

Treatment of streams by which the poison is spreading around.

Soil must be treated by drainage, etc.

Houses should be constructed to keep out the air from soil by means of concrete under house, etc., and by having

thorough ventilation. Food should not be stored in basement when diseases like diphtheria, typhoid fever, and diarrhœa are prevalent.

A water supply spreading disease like typhoid, etc., indicates the necessity of finding new supply; and, until this is obtained, of the thorough boiling of the water before use, and the cleaning of all pipes, cisterns, and reservoirs in which water is stored. When a new supply is obtained all old cisterns, pipes, etc., must be disinfected.

All drains must be seen to, and all faults discovered and repaired as far as possible. All masses of rotting and stinking material must be immediately removed from the neighbourhood of houses.

If food be spreading disease from any centre of origin or distribution—*e.g.* infected milk from infected dairy—that source of supply must be given up until the danger is removed.

Infected clothing depots, and the clothing they contain, to be stringently disinfected.

FOURTH METHOD OF PREVENTION

Preparing constitutions of those exposed to the disease, so that they may resist it.

Thoroughly healthy living tissues resist disease better than weakly and unhealthy ones. When exposed to infection we must neglect no precaution to keep ourselves as healthy as possible. Regular and proper food must be obtained; regular outdoor exercise taken; plenty of fresh air must be admitted into our dwellings; and all excesses scrupulously avoided.

Sometimes the poison is so virulent that the healthiest tissues cannot resist it. In cases, such as small-pox, we can alter the chemistry of our bodies so that the otherwise all-powerful poison is unable to get a firm hold.

Drugs, like quinine, are sometimes taken to prevent an individual having influenza. They are often taken in such excess as to seriously damage the body, and must be avoided, unless used under medical supervision. Alcohol, for this purpose, generally renders the body more susceptible to the disease.

A little knowledge of the ways in which the poison leaves the body in each of the more common of the communicable diseases, the streams whereby it is spread about, and the length

of the time during which they can communicate the poison to others, is necessary in order that the above-described ways of prevention may be rationally applied.

It is also advisable to know the period of incubation of each disease. It varies in different diseases, and also, within certain limits, in different cases of the same disease. The longest incubation period should be made quarantine time for children, after disinfection of the house.

Measles.—Period of incubation, four to fourteen days. The disease is more severe and more fatal in the earlier years of life than it is in the later. One attack generally, but not always, protects the individual against future attacks.

Overcrowding, bad food, and excessive fatigue, increase very largely the severity and mortality from measles.

Measles is infectious from the first symptom (generally cold in head, sneezing, etc.) until the patient is perfectly well.

The poison leaves the body by the discharges from the respiratory passages, eyes, and ears, and also by the branny scales from the skin. It spreads through the air directly from the patient, from infected bedding, handkerchiefs, clothes, carpets, curtains, books, toys, food utensils, and other things in the reach of the patient. It generally enters the body of its victim by being breathed in the air.

Isolation from the first, with attention to disinfection of the above-mentioned discharges, and the keeping of susceptible children away from the inhabitants of the sick house, are the most necessary precautions.

Whooping-Cough.—The deaths directly from whooping-cough and measles are only a part of the mortality resulting from these diseases. By them the lungs are often so altered that on their altered tissues the germs of consumption are easily planted, and may cause death at a later date. The necessity for precautions to prevent these diseases is therefore great ; unfortunately, they are frequently neglected. Parents, at times, think they are a necessity of childhood : this fallacy goes hand-in-hand with another—*i.e.* that, like falling in love, they are worse in older than in younger patients ; a great mistake in both cases.

Period of incubation, seven to twenty-one days.

It is infectious from the first symptom of cold and cough, sometimes three weeks before the whoop begins, and remains infectious until the patient is well.

The poison leaves the body in the breath, and secretions coming through the mouth, throat, and nose. The poison is thick in the air round the patient, and sticks readily to all clothing material. Visitors to the sick can carry infection in their clothing to others.

Isolation of patient is necessary; immediate disinfection of matter coughed up or expectorated, and also of clothing, utensils, toys, etc.

Scarlet Fever (scarlatina).—Period of incubation, few hours to seven days.

Bad smells, etc., in house, make scarlet fever more severe.

It is infectious from the first symptom of the disease until all peeling of the skin is finished. The skin from the palms of the hand, and soles of the feet is generally the last to separate.

The poison leaves the body of the patient by the breath, by the discharges from the throat, nose, and mouth, by the scales from the skin, the discharge of abscesses, etc., that sometimes occur in the neck, ear, and other places during the disease. The urine probably also contains the poison. The infective particles can be carried a short distance through the air by dust; they are often carried from one place to another by the clothing, etc., of healthy visitors to the sick. Bedding, clothing, curtains, carpets, books, cups, spoons, and other articles used in the sick-room can retain the poison for a very long time, and the disease is very often spread by such articles being used without thorough disinfection.

Strict isolation of the patient is demanded, and the most extreme care in dealing with all expectorated matter, discharges, and urine. All clothing used by the patient immediately before the disease was noticed, and during illness, and everything in the isolated part of the house, must be, without exception, most carefully disinfected before being used by anyone else.

Cows are liable to scarlet fever, and all milk during epidemic times should be boiled before being used.

Dr Klein says that cows suffering from scarlet fever show more or less the following symptoms:—

(1) Sores or scurfiness in parts of the skin.
(2) Loss of hair in patches.
(3) Eruption on teats and udders, followed by sores, with dark brown scabs.

Diphtheria.—Period of incubation, from few hours to seven days.

It is infectious from the first symptom until at least a fortnight after all membrane has gone from the throat.

In ordinary cases of diphtheria the infective matter is given off by the breath, and matter from the throat, nose, and mouth. The patient must be isolated, and these discharges destroyed.

The spoons, plates, forks, etc., used by a diphtheria patient very often communicate the disease. They must be most carefully disinfected, and also all bedding, clothing, etc., used in the sick-room and by the patient immediately before he is laid up. The disease may be spread by the clothing of visitors.

Kissing, and close attention to the patient, very often infects those attending the little sufferers.

When diphtheria is prevalent many people have very slight sore throats, and sometimes these are mild cases of diphtheria. On this account no child with any relaxed or sore throat should be allowed to attend school until perfectly well again. Such mild forms of diphtheria often give rise to others of the severe form.

Many causes make our throats liable to receive the diphtheria poison. The chief of these causes are damp, cold houses, wet soils, bad smells near and in houses, bad water, and overcrowding.

Cats get diphtheria, and give it to human beings. Cats suffer from discharge from eyes and nose and bad cough when infected by diphtheria. Sick cats should never be fondled or played with. In diphtheria times cats showing such symptoms had better be destroyed. It is very little use to take elaborate precautions in isolating a human patient if the domestic cat is allowed to sit in the kitchen coughing, sneezing, and expectorating diphtheria poison all over the place.

Cows are also liable to diphtheria, and their milk then contains the poison. Some authorities deny this, and say all milk epidemics have probably a human origin.

Cows with diphtheria have for a day or two a slight fever that is often unnoticed. A soft tumour of the skin is sometimes seen, but often is unnoticed also. The cow loses its appetite for a few days. In five or six days a chappy eruption comes out on the teats and udders.

During diphtheria times milk had better be boiled, or treated as described (p. 112).

German Measles.—Incubation period, five to twenty-one days.

It is infectious throughout the whole period of the disease. Infection passes directly from the patient, and by infected clothing.

Influenza.—Incubation period, few hours to five days.

Infectious throughout whole course of disease. The breath and sputum and nasal discharge of patients contain the poison and transmit it directly, or through the medium of dust and clothing, to others.

Mumps.—Incubation period, fourteen to twenty-five days.

It is infectious from the first symptom of illness until two or three weeks after the swelling has appeared. It is spread chiefly by the patient's breath.

Typhoid Fever.—Incubation period, eight to twenty-three days.

Infective from first symptom until about one or two weeks after diarrhœa has stopped.

The poison leaves the body by the bowel discharges, and gets more virulent after being exposed to air for a time. The bowel discharges, and any clothing material soiled with them, must be disinfected without delay. It has recently been *proved* that the urine of typhoid fever patients is highly infectious, especially in later stages of the disease, and so must be disinfected.

The poison enters the body of its victim by food or drink. It may get to the food by the soiled hand of those eating it, or by dust containing any dried bits of the bowel discharge settling on the food, by flies carrying on their feet some of the bowel discharges, or by sewage matter getting access to the water supply. Milk may be contaminated by filthy teats of cows, by dirty hands of those milking the cows, or by contaminated water, used to clean the vessels containing the milk, or to dilute the milk.

Typhoid patients should be isolated. Those attending patients should always wash their hands in carbolic acid solution, and then well with soap and water, before taking their meals, and they should never on any account eat anything in the sick-room.

Drinking water and milk during epidemic times should be boiled for five minutes. All articles of food coming in contact with unboiled water should be cooked before eating, and the

surface of all fruits, etc., eaten raw should be well washed in boiled water before they are eaten.

Shell-fish from mouth of rivers contaminated with sewage coming from places where typhoid fever exists, or has recently existed, should never be eaten raw.

Fruit-pickers, or others dealing in any way with food materials, should not continue their employment when suffering from any diarrhœal affection whatever.

Epidemic Diarrhœa. — Incubation period, less than twenty-four hours.

This disease affects children more seriously than adults, and is the great cause of the high infantile death-rate in this country.

The poison probably leaves the body by the bowel discharges, and readily infects the soil, in which it can lie a long time. During the cold weather, and when the soil is very cold, then the germs in the soil lose for a time their activity. Extremely dry or extremely wet soils do away, at all events for the time being, with the virulence of the poison as it exists in the soil.

It enters the body with the food.

The conditions helping on the disease are (1) overcrowding, (2) dirty, dark houses, (3) houses in which the air from the soil enters the house, (4) storage of food for infants and young children in cellars, (5) sewer air, and other bad smells in the house, (6) bad water, (7) the practice of feeding infants by hand, especially when they are fed from the bottle (when fed by the spoon hand-fed babies are not so liable to diarrhœa), (8) any neglected condition of children—as, for example, when the mothers go out to work, (9) contamination of soil with organic matter in immediate proximity of house (unpaved yards, soaking privys, etc.), (10) improper feeding of infants and children, (11) hot weather.

Cholera.—The causes and prevention are almost the same as in the case of typhoid fever.

Typhus Fever.—Incubation period, one to twenty days.

It is infectious throughout entire course of disease. Overcrowding, filth, and poverty lead to the development of typhus. The infectious poison is probably mostly given off by the breath and exhalations of the skin; it loses its virulence by plentiful dilution with fresh air.

Isolation of patient, with most thorough and complete ventilation of sick-room, is necessary.

Chicken Pox.—Incubation period, thirteen to nineteen days. Infective period, from appearance of eruption until all scabs are gone from the skin.

Poison leaves body by the skin, and is carried about in air, in dust, or clothing material. Clothing of visitors to sick can convey the disease to others.

Small-pox.—Period of incubation, seven to eighteen days. It is infectious from the first onset until every particle of scab has gone from the skin.

The poison leaves the body by the breath, by exhalations from the skin, by the contents of the blisters and pustules on the skin, and mucous membranes, by the scabs on the skin, and perhaps, also, by the discharges from the kidneys and bowels.

The infective particles can be carried through the air for a long way, probably farther than in any other disease; it may also be taken from house to house by air of drains and sewers. Clothing material, all articles in the sick-room, the bodies and clothing of visitors, can convey the poison for considerable distance with the greatest ease. Rags, etc., used in paper mills, etc., long after contact with small-pox, have given the disease to mill hands. Dead body of patient is virulently infective.

Strictest precautions of isolation, and immediate destruction of infected rags, and disinfection of other clothing, are imperative. Proper vaccination, and re-vaccination, protects against small-pox. The effect of vaccination is gradually diminished in the course of years, but the vaccinated individual is always less likely to get a very severe attack than if he had not been vaccinated at all.

STATISTICS FROM RECENT EPIDEMICS REGARDING EFFICIENCY OF VACCINATION

ALL DOUBTFUL CASES OF VACCINATION INCLUDED UNDER HEAD OF VACCINATED

Epidemics.	Vaccinated Patients Attacked.	Deaths.	Per-centage.	Unvaccinated Attacked.	Deaths.	Per-centage.
1887-8 at Sheffield .	4151	200	4·8	552	274	49·6
1892-3 ,, London .	1753	39	2·2	409	99	24·2
1891-2 ,, Dewsbury .	645	18	2·8	366	92	25·1
1892-3 ,, Warrington	593	38	6·4	68	24	35·8
1892-3 ,, Leicester .	199	2	1·0	158	19	12·0
1895-6 ,, Gloucester	1211	120	10·0	768	314	40·9

If one will not admit the evidence of statistics—to be prepared, in fact, to deny that 2 and 2 make 4—it is quite possible to urge many things against vaccination.

Erysipelas.—Cases of this disease should be isolated, and all clothing, bedding, etc., that has been in contact or near an erysipelas case, must be most carefully disinfected, and also the isolation-room after the patient's recovery.

People suffering from wounds of any kind must most carefully avoid coming in contact with erysipelas infected cases, or material.

Puerperal or Child-bed Fever.—This is a serious and often fatal disease. Infection of the room or instruments, clothing, attendants, and others, with matter discharges from foul ulcers, or discharges from any part of the body, from the discharges of a previous case of puerperal fever, by sewer air or other such bad-smelling germ-laden gases, by the poison given off from erysipelas, diphtheria, and other infectious fevers, are most common causes of this disease.

CHAPTER XVII

TUBERCULAR OR CONSUMPTIVE DISEASE—ANTHRAX, PURULENT OPHTHALMIA

Consumption is generally known as a fatal disease attacking the organs in the chest. It may attack almost any part of the body. It is a common disease of the bones and joints, of the bowels, of the brain and the skin. It attacks not only man but also many of the lower animals. The disease is caused by a minute living germ. This germ is expectorated by millions in the matter from the lungs of patients suffering from consumption of the lungs—as many as 20,000,000 daily in some cases. This matter, if allowed to dry, is scattered about in dust, with the germs still alive and attached to them. These, if taken into the body of susceptible men, or animals, may produce the disease. The scattering of the expectorated matter about is the commonest cause of the spread of consumption, and next to it is the use of food, especially dairy products,

derived from tubercular animals. Tubercle bacilli enter the body by being breathed with the air, ingested with solid and liquid food, or innoculated in skin or mucous surfaces.

The liability of the body to become infected by consumption is largely increased by certain conditions, notably:

(1) Prolonged indoor work, especially in dusty places. Shortening the hours of shop assistants would considerably reduce the consumption among them, and the consumption spread by them to others.
(2) Want of ventilation in rooms, and overcrowding.
(3) Any want of regular outdoor exercise.
(4) Neglect of ordinary coughs and colds, or the too early stopping of bronchial coughs by taking patent and other cough mixtures that stop the cough, and allow, in consequence, dead matter and irritants to remain in the tubes.
(5) Living in damp houses, and on damp, undrained soils.
(6) Improper clothing.
(7) The breathing of irritating particles of dust, as stone chips, etc.
(8) Enlarged tonsils, and other throat troubles.
(9) Diseases leading to obstruction of nose.
(10) Great debility.
(11) Acute fevers.
(12) Alcoholism.
(13) Digestive and bowel troubles.
(14) Heredity is not only a predisposing cause, but occasionally the child is born with the germs actually existing in its body. Fortunately, inborn tuberculosis is probably very rare; the child is usually born with a weakness of its tissues to resist the ravages of the tubercle bacillus, and is infected at a later date. Cases where in a family one member after another succcssively succumbs to this dreadful disease are now known not to be due to an inevitable fate, but are generally cases of infection one from another, which, with care, might have been prevented. Children of consumptive parents, or with a history of consumption in any of their near relatives, should always, when possible, be brought up in dry and

equable climates, and should be persuaded to follow a vocation in life in which they will have plenty of outdoor work, and be as little as possible shut up in offices, shops, etc. Above all things, they must avoid association with consumptives.

(15) Age conditions. Generally young people fall easier victims to tubercle. Primary intestinal tuberculosis nearly always occurs in children.

Infection from man to man.—Bacilli leave the body with discharges, especially those coming from diseased areas—*i.e.* sputum, nasal discharge, abscess discharge, bowel discharge, urinary discharge, and, in small numbers, with matters, etc., from tubercular skin diseases.

A handkerchief used to receive the sputum of a consumptive patient, and replaced in the pocket, puts countless germs into the clothing of that individual; the handkerchief, when taken out, perhaps with a shake, spreads around in the air microscopic particles of fluffy dust, laden with death-dealing germs. The sheets, pillow-cases, etc., used by consumptive people become freely infected with the germ, and if used by anyone else, without being boiled or otherwise disinfected, may give some form of the disease. The expectorated matter on floors or the ground dries up, and infects the house or district with the disease organisms.

Hotel-keepers and others may do deadly wrong to their guests by giving them sheets, etc., used by a previous visitor, which, not being visibly soiled, have not been washed, but merely sprinkled with water and passed through the mangle.

No precaution should be neglected that may lead to the destruction of these germs as soon as possible after they leave the body of the patient. The patient should expectorate into special vessels, and the matter be dealt with as described at p. 97. The method by burning is undoubtedly the best for the purpose.

If handkerchiefs are used they should be changed frequently and soaked in disinfecting solution, and then boiled in it. Japanese paper handkerchiefs might be used, and immediately destroyed. Expectoration out-of-doors is less dangerous than indoors. Sunlight is destructive to tubercle bacilli. Such expectoration is very dangerous in public conveyances. On

no account whatever should infected handkerchiefs be sent to the common laundry. Laundry people, moreover, should always well boil handkerchiefs, pillow-cases, and sheets; and after being boiled they should not come in contact with any that have not yet been boiled, or placed in water in which unboiled handkerchiefs have been placed. One of the most distressing forms of tuberculosis is tubercular lupus of the skin. This disease frequently attacks the skin of the face, especially of the nose, and leads on, by steady ulceration, to destruction of the skin and nose, often rendering an attractive face a hideous and repulsive sight. It is known to have arisen from use of handkerchiefs of consumptive people. It may also arise, and probably often does, from rubbing in cracks of a catarrhal skin bacilli transferred to handkerchiefs at the laundry. The moral guilt of causing such disease may rest on any who wilfully neglect the above precautions in regard to handkerchiefs and bedding.

Enlarged glands and abcesses in various parts of the body, especially of the neck, are often localised results of the growth of the consumptive germ. The matter, etc., from such disease must be carefully and immediately burnt.

Houses and rooms inhabited by consumptive patients require careful disinfection. Many cases are known where healthy families have become infected after moving into a house where a consumptive case had previously been. On this account there is danger to non-tubercular invalids and convalescents staying in lodgings at resorts where consumptives flock to live and die. A sea voyage for health may become one of death by sharing a cabin with a consumptive patient.

Infection from animals to man, and vice versa, occurs principally from use of tubercular food. The most dangerous form is that transmitted by oxen. Tubercle bacilli generated in body of the ox are especially virulent. Unfortunately, the detection of the disease is often very difficult in its earlier stages. The milk, cream, and butter of tubercular cattle frequently contain tubercle bacilli, but this, however, is only in cases where the udder is diseased. Tubercular disease of udder may occur early or late in the course of the disease; in some cases it occurs so early that signs of the general disease are not detected by ordinary methods. Tubercular disease of udder may be manifested by a hard, nodular, painless, or slightly tender

swelling, and the milk usually fails in quantity or quality in one quarter of the udder. Either of these signs should lead to an exclusion of the milk of such cattle from public supply. It may be used separately, the cows isolated, and the milk received in special pails and boiled before it is given to animals. Milk also is in grave danger of infection by fœcal matter. Cowsheds and their neighbourhood are not always as they should be, in an ideal sanitary condition.

Cows suffering from tubercular disease of lungs do not, like human patients, expectorate, but swallow lung discharges coming into the mouth. Consequently, a large amount of tubercular matter is passed into the alimentary canal, and the fœces are very frequently infective. Dust in air, dirt from udders, tails of cattle, dirty hands and clothes of milkers, frequently allow fragments of dried excrement to fall in milk pails.

Children are frequently infected with tubercle by milk. They are very liable to intestinal tuberculosis. The alimentary canal of adults has a far greater power of destroying tubercle bacilli, and is less liable to infection. Enlarged tonsils forms a favourite entry for tubercle bacilli. Milk, etc., sticks to their surface, and bacilli pass through the mucus membrane and are taken by little channels to the glands of neck, where they often give rise to abscess and consequent disfiguring scars. Bowel and stomach troubles render the intestinal canal more liable to local infection. This is unfortunate, as in these cases a milk diet is often required.

Boiling the milk for a few minutes destroys the bacilli. Boiled milk, however, has a taste that many people dislike, and as a nutriment for infants is impaired. The infective power of the milk may be removed without actually boiling it. A double saucepan is required, or a jar placed inside a saucepan. A certain amount of milk (say, a pint) is placed in the inner saucepan or jar, and double the amount (say, a quart) of water in the outer. The double sauce-pan is put over a good fire. When the water in the outer vessel boils the time must be noted, and the water kept boiling *not less than* twenty minutes. During this time the milk in the inner vessel must be frequently stirred. In this way the infective milk loses its dangerous properties.

The flesh of tubercular animals is also dangerous. When the tubercular process is generalised—*i.e.* attacking more than one cavity of the body, or extensively spread through one

cavity—the carcase should be destroyed, as the flesh then is probably infected. If the disease is localised to a small area of one cavity, the danger of general infection of the flesh is very slight. The great danger in such cases is that the butcher's knife, smeared with virulent matter from the tuberculous area, may be used to cut a joint used for food. If such a smeared cut is rolled, the danger is a real and serious one.

Cookery is incapable of killing tubercle bacilli situated more than two inches from the surface of the joint. Those on the surface are always destroyed. The danger of smearing is therefore confined to rolled joints. If such joints are plunged in boiling water before rolling the danger is removed.

Pigs and poultry are often tubercular. Pigs are frequently infected by milk. Fish may be infected. In one case, a pond stocked with carp received expectoration and bowel discharge of tubercular patient, and a great number of the fish died of consumption. Tubercle bacilli from fish lose most of their virulence; those from birds are also of somewhat diminished virulence.

ANTHRAX is one of the most virulent of diseases. It is caused by the anthrax bacillus. Anthrax bacilli, when exposed to the air, form spores inside their tissues. Anthrax spores are extremely hard to destroy. Anthrax infects man by blood or tissues of animal dead of anthrax being applied to skin or mucous surfaces, to cuts and abrasions, and by being inhaled in dust—*e.g.* from wool and hides of infected animals—and by being ingested in food. It is a very severe and generally fatal disease. Cattle and sheep are frequent victims.

They are infected in the following ways :—

I. INFECTED PASTURES.

- Spores brought to surface from badly buried carcases (agency of earthworms, etc.).
- Droppings of infected animals.
- Blood discharge from mouth and other openings of infected animals.
- Infected manure—*i.e.* byre, bone, blood.
- Brought to pasture by overflow of infected river. (Infection of river by drainage of infected land; infected animals; washings of wool factories; infected blood washed into stream.)

II. INFECTED BYRES, STABLES, ETC.

III. INFECTED FOOD.
- Grazing on infected pastures.
- Imported infected corn and fodder.
- Roots from infected soil.
- Pigs, etc., fed on infected entrails.

Prevention of Anthrax. Case A.—Animal of flock found dead in field.

Order of Procedure: (1) Report case to Local Authority. (2) Dispose of carcase, (*a*) by cremation, (*b*) by burial.

Cremation.—Carcase must be completely covered and surrounded by quicklime during removal. Cart, etc., to be afterwards disinfected.

Burial.—(1) Don't open body: exposure of internal part leads to spore formation. (2) Bury where found, unless near well or water supply. (3) Grave at least six feet deep, one foot of quicklime at bottom, and completely surround carcase with a similar depth of lime. (4) Replace soil, and beat down well. (*N.B.*—It is illegal to dig up the carcase without an order.) (5) Site where carcase was found, and all traces of blood discharge, to be covered with quicklime and fenced off for six months.

Case B.—Animal dead in byre, stable, etc. (1) Remove animal, in quicklime, for burial or cremation. (2) Burn all fodder, litter, etc. (3) Sprinkle whole of shed, cart used to remove carcase, etc., with carbolic solution (p. 96). (4) Scrape, and burn scrapings. (5) Scour everything with carbolic solution. (6) Lime-wash every part of byre with freshly-burnt lime and water, with half-a-pint of carbolic acid to the gallon.

Remainder of flock to be removed to fresh pasture, fresh water, etc. Examine each animal, and take temperature daily for a week. If any animal shows rise of temperature it must be isolated.

Infected Pastures require heavy top-dressing of lime for at least six weeks. If, despite this, anthrax continues to break out, plough the pasture up, and plant it with trees.

Purulent Ophthalmia, or inflammation of the eye, with mattery discharge.

This disease is not uncommon in infants, and is often the result of neglect in cleaning the child after birth.

It occurs also in children and adults as result of bad air and filth in the living-room, dirty bed and other clothes, especially if at the same time the child is badly fed.

It also results from getting particles of mattery discharge from other parts of the body into the eye.

This disease, if neglected, very often leads to such severe destructive disease that the sight and eye are hopelessly lost. If properly treated in an early stage the sight can be saved, except in a very few cases where some specially virulent matter has been inoculated.

The discharge from the eyes can infect other people. Therefore, all matter, and rags or clothing soiled with this matter, should be destroyed. The patients must be isolated, and towels, sheets, pillow-cases, etc., used by them thoroughly boiled before others are allowed to use them.

Those attending the patient and applying remedies, syringing the eye, etc., must take great care that none of the water from the syringe, etc., splashes back into their own face and eyes.

CHAPTER XVIII

SOME PARASITIC DISEASES—RICKETS, AGUE

Ringworm is a disease caused by several forms of mould fungi. When the hairy scalp is attacked, as it often is in children, the disease is frequently most difficult to cure. The scales and broken bits of hair contain an immense number of the germs' spores. These can be carried about in the air. They remain easily attached to linings, etc. of hats, to bedding, and to hair-brushes and combs. Children putting on, even for a short time, an infected hat are liable to get the disease.

Prevention lies in endeavouring to prevent the mixing of ringworm-infected with healthy children. Cotton or linen caps, covering the head, should be constantly worn, changed daily, and boiled. The out-of-door caps worn over these are less likely to be infected, but still they often are so, and on this account must be strictly kept from those of other children.

The shaving of the scalp, followed by keeping the hair extremely short, and the application of oily remedies containing germ-killing material, help to prevent infection, as well as cure the disease.

Ringworm must on no account be neglected. Regular and persistent treatment is required. As a rule, it is better to keep ringworm children away from school. If they are allowed to attend they must be kept away from the others in one part of the room, precautions as above being taken regarding their scalps. They should be dismissed half-an-hour before the other children, and should come to school at an earlier time.

The teacher should receive their hats, and put them away, and the heads of all attending the school should be examined weekly ; the slightest scurfiness should be at once reported, and the child medically examined.

The incubation period of the commoner form of scalp ringworm may be as much as fourteen days.

The Itch.—This disease is due to a small, almost microscopic living spider that bores its way in the skin, lays eggs in its burrow, in which young ones are hatched and continue the trouble.

Beds and clothing are readily infected with the animal, and easily transmit the disease.

The animal is destroyed by boiling or baking the clothing, or by dry-ironing them with an iron heated just below the heat required to scorch the clothing.

Lice in the Heads of Children.—These frequently give a great deal of trouble, and often are the cause of severe skin disease and glandular abscesses.

An effectual means of destroying head lice consists in cutting the hair short and soaking for a time the scalp in the ordinary petroleum used for lamps, and then washing well with soap and water. Of course, during the soaking all lights, etc., must be kept away. It must not be forgotten that the hats worn before treatment will probably contain the insect, and that hats, brushes, and combs frequently spread them from one to another.

Bed Bugs.—The irritating swelling caused by these insects can be soothed by bathing the place with a little liquid ammonia and water.

Bedsteads infected with bugs must be taken to pieces, and every joint separated, and then the whole bedstead well scrubbed with the solution of corrosive sublimate.* (See page 97.) After

* The early spring is the most important time to attend to this trouble.

using the corrosive sublimate solution, the bedstead must be well washed with a strong solution of washing soda. Instead of the more poisonous corrosive sublimate solution, a strong mixture of chloride of lime and water may be used.

After this washing has been done the windows of the room should be closed, the chimney blocked up, and the bedding arrayed about the room, and one or two sulphur candles burnt.

Fleas object very much to the smell of lavender. A little of the cheap foreign lavender oil goes a long way. One or two drops on the night-dress and bedding generally keeps fleas away. Twigs of lavender put between the bed-clothes are also very efficacious.

Foul-smelling Feet are the result of the growth of minute living germs in the outer skin. The germs infect stockings, boots, and bedding used by infected patients; these, if used by others may transmit the trouble. The feet should be soaked in hot water with as much boric acid dissolved in it as possible, and all the loose macerated surface skin removed, and the feet again soaked. Cotton socks should be boiled, and woollen socks soaked in strong carbolic acid solution (p. 96). Boots of little value should be destroyed, others should have dry boric acid well dusted in, and a cork sock put in them. The stockings or socks should be changed once or twice a day, the cork socks taken out at night and soaked in the strong carbolic solution.

SOME WORM-CAUSED DISEASES

There are many kinds of tape-worms infesting man's intestines. The most common form is the *Taenia solium*. This is a long, ribbon-like worm, infesting the intestines of man and lower animals. When the worm reaches its full size—about 12 feet long—little segments are broken off the worm, and pass out with fœces. These segments are full of microscopic eggs. They wriggle about a bit after being passed out of the body, and then die. The eggs, however, retain their vitality for a long time. During their life in the intestines, tape-worms cause such symptoms as colic, diarrhœa, and constipation, nausea and dyspeptic symptoms, anæmia, and sometimes in children, severe nerve symptoms. The eggs, if eaten by another animal, pass through a new phase of existence. Pigs often eat whole segments full of eggs. When

the eggs have passed into the intestines of their new host, a little animal provided with boring spines is hatched. It bores its way through the walls of the intestines, and invades various tissues. In the pig it generally infects the muscles. It forms a tiny bag, in which the head of the ordinary tape-worm develops.

The tape-worm cysts (*cysticercus cellulose*) can be seen as small round, whitish yellow bodies, scattered through the flesh (measly pork). During life they can often be recognised on the under surface of the tongue. They are killed by a temperature of 57-60 deg. C., and so are not killed in underdone meat. Man is infected by eating the cyst alive, and the head fixes itself by suckers and hooklets to the walls of the intestines, and then in about sixty days develops into the adult tape-worm. The eggs are sometimes taken by man in contaminated drinking water, in food, by soiled hands, and occasionally from tape-worms in his own intestines, and serious if not fatal disease may result. The newly-hatched boring animal sometimes finds its way to the back of the eye, to the brain, and other vital organs. Unfortunately, in the brain the cysts grow to a large size. Blindness, paralysis, convulsions, obstinate and confirmed epilepsy, and even death, may result. Probably many epileptic idiots in our country places are instances of the evils resulting from drinking filthy, excrement-contaminated water. Intestinal tape-worms must not be neglected. The symptoms produced by them may not be very serious, but each individual with a tape-worm inside is continually evacuating thousands of tiny eggs, capable of producing the most dire and dreadful maladies. Until the patient is cured his excrement should all be burnt.

Trichinosis.—A serious and often fatal disease in man. Man is infected by eating flesh of infected animals, almost invariably pigs. The muscles of infected pig contain great numbers of very tiny cysts, each containing a little, coiled-up, round worm. (Fig. 33.) When eaten unkilled by cooking, the cysts are dissolved in the stomach. In the intestines the little worms grow into much larger ones, and give birth to large numbers of tiny worms. The new-born worms bore through

Fig. 33.—Trichina Embryo in Muscle (magnified).

the walls of the intestines and find their way to the muscles, and finally, if the patient survives, again form cysts, and the painful and dangerous disease stops. The flesh of infected animals should be destroyed. Unfortunately, the tiny cysts are not easily detected. The closest naked eye inspection reveals at the most an exceedingly fine speckled appearance of the flesh. Special preparation, and microscopic examination of sections, are necessary to distinguish the parasite. (Fig. 33.) Cookery, if very thorough, generally destroys the worm; but the meat must be very well done. Smoking and drying are useless. Rats are very often infected, and pigs should not be fed on dead, uncooked rats. When known to be infected, pigs ought to be killed, their bodies and manure burnt, and all vermin hunted down and burnt.

Tape-worm of dogs.—Like *Taenia solium* tape-worms infecting dogs have a bladder state in other animals. One form, *Taenia coenurus*, has its cystic state in brain of sheep, and causes the disease "turn sick" or "gid." Another tape-worm, a small one known as *Taenia echinococcus*, has its bladder life in man, in whom it forms huge cystic tumours in internal organs, which if not operated on are frequently fatal. In both cases the eggs pass out of the dog's bowels and infect grass for the sheep, vegetables, water, etc., for man. Infection of man may occur through dogs licking them. Tape-worm in sheep and other dogs must be promptly treated, and until they are cured their excrement should by destroyed by fire.

A large round worm (*ascaris lumbricoides*), resembling somewhat the ordinary earth-worm, sometimes lives in intestines of man, the symptoms are usually not serious, but at times the following troubles arise: Dyspepsia, occasional griping pains, irregular bowel troubles, erratic appetite, mal-nutrition, anæmia, at times various nervous symptoms (convulsions, etc., in children) and occasioning fatal inflammatory trouble. Enormous numbers of little eggs pass out with every bowel discharge. The disease is spread by water and vegetables contaminated with sewage. Water should be boiled; vegetables eaten uncooked should be previously soaked in salt and water, and then washed well with boiled water. When known to exist in intestines the excrement should be cremated until the patient is cured.

Small *thread-worms* frequently reside in the lower bowel, in which they may exist in enormous numbers, and give rise to

great irritation and sometimes serious trouble. Worms are full of eggs, pass out with bowel discharge and at other times.

Disease is kept up and spread by swallowing eggs and crushed worms in water, with uncooked fruit and vegetables, by dirty fingers taking them to mouth, and from clothing and bedding of infected children.

Rickets.—A serious disease associated with nutrition; it is seen in infancy or early childhood. Its early recognition may save disablement and death. The first indications are attacks of vomiting, with offensive diarrhœa; later on child sweats profusely, especially about head, at night. It throws the bedclothes off. Development is checked; child becomes backward; a general tenderness of whole body is felt; child fears to move; ends of bones enlarge; the unduly soft bones bend under pressure and gravity; and serious deformities arise.

The development of all infants should be observed. First year, child should grow about 8 in.; second year, about 4 in.; third year, 2-3½ in.; fourth year, 2 or 3 in. In weight from first to tenth year there should be a yearly gain of 4-5 lbs. The soft place (*anterior fontonelle*) of infant's head at birth should be about the size of a florin; at sixth month, about the size of a shilling; at twelfth month, about the size of a sixpence; at twentieth month it is not perceptible to the touch. In rickets this is altered, the soft place remains large. The teeth are cut later: if tenth month is reached and no teeth are cut, investigations should at once be made.

The chief causes of rickets are: bad food, bad air, want of sunlight, damp cold rooms, want of exercise and cleanliness. Treatment consists of removing all the above causes, combined with careful medical treatment, and posturing child to stop development of deformities.

Malaria or Ague.—There are several varieties of this disease caused by varieties of microscopic animal germs more or less seriously breaking up the blood corpuscles. Incubation period averages from six to twenty days, but may be shortened to a few hours. Soil conditions favour and cause this disease. A moist soil of high temperature, saturated with decaying vegetable matter, and swamps with plenty of gnats and mosquitoes flying about are the most favourable conditions for this disease. In England improvement of soil has almost banished the disease. Thus, in Sussex, in the neighbourhood of Littlehampton, it was

once a common disease, known as "Littlehampton Shivers." It is now utterly unknown, and the district has become distinctly a favourite health resort. Among the preventive measures are: thorough and deep drainage of the soil; removal of masses of decaying vegetation, and sometimes of thick brushwood; judicious planting of trees; turfing the ground; obtaining a good water supply. When living in malarious districts avoid sleeping on ground floor, wear flannel next skin, to avoid risks of chill after sunfall. Agricultural and other occupations in turning up soil to be avoided in evening.

CHAPTER XIX

THE SKIN AND BATHING

The skin is a complicated structure containing a number of organs that have very important parts to play in the preservation of health.

The skin's work consists of—

(1) Protecting the body surface against external injury, poisons, and against the attacks of disease germs.

(2) Helping the body to get rid of poisonous waste products, which, if they were allowed to accumulate in the body, would undermine health, and perhaps destroy life.

(3) Regulating the heat of the body, and enabling it to withstand alterations in the outside temperature without altering that inside. A comparatively slight alteration of the natural temperature of the body results in disease and death.

(4) The skin is the site of the sense of touch, pressure, temperature, and pain, and thus by its means a great portion of the knowledge of the outside world is obtained, and without which injuries would constantly result, and perhaps loss of life.

(5) Respiration, to a slight extent.

Among the many causes that interfere with the healthy action

of the skin are (1) uncleanliness, (2) sudden changes of temperature to those who, by excessive precautions and coddling, are not accustomed to such changes, (3) improper clothing, (4) extreme exposure to great heat or brilliant light, (5) various irritants and parasites, (6) the absurd use of such things as cosmetics to the skin, in the form of various paints and powders, (7) irritation of stomach by bad food or by food in excessive quantity, and also irritation of other internal organs, (8) excessively vigorous cleanliness, especially the use of coarse irritating soaps and reckless friction with bad towels on delicate and easily irritated skins such as the skin of infants.

Bathing.—Three different functions of bath. (1) As a cleansing agent; (2) training to heat regulation, and so as means of protection against chills; (3) sedative, rest-giving baths.

Cleansing Skin.—Uncleanliness of skin or clothing is a serious detriment to health. (1) It obstructs pores of skin glands, and interferes with secretion—this evil is most marked in those leading sedentary lives; (2) it fosters and spreads infectious diseases, and fosters parasites; (3) encourages rheumatism; (4) makes individuals socially objectionable, and consequently goes hand in hand with moral depravity.

The prevention of the ills of uncleanliness is the proper use of the bath and wash tub.

The order of frequency of washing should be as follows:—

The skin must be frequently washed.

The under vest (if worn) should be washed next in frequency.

The over-shirt should be washed the least often.

Unfortunately, mankind too frequently reverse the above order.

The dirt of the skin is a greasy substance. It is a mixture of fatty matter that oozes from the skin, with little scaly bits of skin, fragments of clothing fibre, the various constituents of dust and soil, and innumerable tiny microscopic organisms. This horrible greasy matter does not mix well with water unless something is added to it, generally soap. Soap has the power of making a small amount of oil mix with water, and thus removes the dirt of the skin. Washing soaps are salts of a series of acids, the fatty acids, with potash or soda. Silicious acid (flint) also can be made to combine with potash or soda, and forms a gelatinous substance capable of cleaning the skin;

this silicate of soda can be mixed with fatty soaps. Silicated soaps, are, however, not suitable for sensitive skins. Resin also is used, common yellow soap contains a good deal of resin soap. Resin soaps may not be so irritating as soaps badly made with common fats, but as toilet soaps they are not so good as well-made fatty soaps.

Fatty soaps are made by boiling fats, such as tallow, palm oil, kitchen refuse, fish oil, olive, almond, rape, and poppy oil, etc., with caustic soda or potash. Marine soap is made with cocoa-nut oil; other soaps are precipitated by common salt, and become useless in sea-water.

Soft soaps are made with liquid fats and potash. Transparent soaps are made by dissolving soap in spirit and distilling off the spirit, and letting the residue stand in moulds, or by adding sugar to the soap. Sugared soaps are not good for the skin; and so it is the experience of many that transparent soaps should be avoided.

Fatty soaps vary in the amount of caustic potash or soda they contain; in many these are present in excess. Such soaps are called alkaline soaps; they cleanse the skin very quickly, but, unfortunately, frequently irritate, and even cause disease in very sensitive skins.

In cases where a soap irritates the skin, the sufferer should try other soaps. Probably the offending soap is an alkaline one, and then another kind must be used—namely, a superfatted soap. There are many excellent superfatted soaps in the market, and the buyer should ask a good dealer to recommend him one of them.

The entire body surface should be washed with soap and hot water at least once a week, in addition to the daily cold bath. The feet should be washed daily with soap and water, and the hands, face, neck, and other exposed parts as often as they appear soiled.

The method of washing ascribed to the orthodox Frenchman, who described his method of washing as follows: "My face I wash often, my hands sometimes, my feet nevar!" is unhappily followed out only too frequently by many of our fellow-countrymen, and few of these possess sound, healthy feet in consequence.

Baths training heat regulation—i.e. *Cold Baths.*—A cold bath may be defined as one in which the temperature is below

88 deg. F., and, consequently, a cold bath may be considerably above the general atmospheric temperature. What is generally known as a tepid bath may act as a cold or tonic one. Between 88 deg. F. and 98 deg. F. the physiological action of the bath is very slight. Such baths may be termed indifferent baths.

The effect of cold baths is increased as the water temperature is lowered. When possible, it is of great benefit to have a cold bath each morning on rising. They must, however, be taken with care.

A plunge into intensely cold water by people who are not accustomed to it is not only a painful shock, but is, in some cases, especially to the aged and feeble, a very dangerous thing. Rupture of blood vessels, or failure of the heart's action, followed sometimes by sudden death, may result from such shock to an untrained or aged body. Nearly all people, the aged excepted, can, however, train themselves to take cold baths. They should begin by using very tepid water, and then gradually, day by day, having it colder and colder.

In cases where a plunge bath is not obtainable, an excellent substitute may be had by wrapping the body round in a wet sheet and rubbing the surface with the sheet, and then rapidly drying with a good towel. A scrub down with a wet towel is a simpler, and more easily obtained, but still excellent means of deriving the effects of a cold bath.

A guide as to whether the cold bath is doing good is found in the sensations that follow the cold bath. These sensations ought to consist of the rapid development after the preliminary feeling of cold and momentary breathlessness and pallor of the skin, of a warm glow over the skin surface, accompanied by a general sense of exhilaration with a capacity for increased bodily and mental work, and an increased appetite for food. Sometimes these sensations of a healthy reaction are absent, and in their place there is a feeling of chilliness, persisting for some time, with blueness of the surface especially of the lips, and depression of all vigour; in such cases the bath taken is too cold, and is doing harm.

The cold bath taken in any of the above ways, and followed by a healthy reaction, aids the body to withstand chills and colds, and increases the general health and vigour of the individual.

Hot Baths are those in which temperature of water is above

98 deg. F. They act as sedatives to the system, and aid the excretion of waste products. After over-fatigue a hot bath is of great value; when, for example, after a long, wearying tramp the muscles of the body ache, and the patient is "too tired to sleep," half-an-hour spent in a hot bath will help to remove the achings and make sleep possible, and even take place of sleep occasionally. A wearied and irritable mind may be rested by the hot bath. A hot bath does harm if the respiration becomes and continues very rapid, and if faintness is experienced; in such cases the water is probably too hot. Old people require to be careful about hot baths. Apoplexy occasionally occurs during or after a hot bath. Old people should never plunge immediately into a very hot bath, a temperature of about 98 deg. F. should be the highest for the first *gradual* immersion, this might be raised a little afterwards but not much. After taking a hot bath the greatest care must be taken in passing out into the cold. The bathroom ought to be warmed, and the bather, enveloped in a large towel, should dry thoroughly. A towel made into a loose gown or long shirt is very useful. Plenty of wrappings should be put on before going out into the colder passages and bedroom, and the bed ought to be warmed. The cold shower that young people may take with advantage after a hot bath is a most dangerous thing for old people. A sudden change from warmth to cold causes a sudden and temporary filling of blood-vessels in deep parts and organs. In old age vessels lose their power of dilating to receive such sudden increase to their contents, they may break under the strain, and this may mean fatal apoplexy.

Bathing of Infants.—Little infants require a daily bath, but at first this must be a warm one. In all cases a good-sized bath should be used, and the temperature of the water to be about 96 deg. F. The child should at first be put gently into the water. A good plan is to gradually lower the infant, lying on a bath towel, into the water, then, when accustomed to the water, it may be completely dipped up to the neck. The body ought to be gently soaped. Only good non-irritating superfatted soaps should be used, and these gently applied as lather on a soft sponge. The lather should then be completely swilled off the surface and the child carefully dried, without violent friction, by means of a soft towel. After the skin is completely dried the parts of the body where the skin surfaces come in

contact, or where the clothing is likely to rub, or where the skin is liable to be wetted should be freely dusted over with fine starch powder. As the infant gets older the water of the bath may be gradually cooled in the warmer parts of the year, and if the child is born in the spring time it may by time it reaches three months old have a bath about 70 deg. F. In very delicate infants the advice of the family doctor must be sought in regard to the way of bathing. After this age the child may, if robust and strong, have even colder baths, providing that as it is gradually accustomed to colder and colder water it is carefully observed whether a good red glow appears on the skin surface after the bath. If, on the other hand, the child remains in any way blue and cold, it shows that the progress of training to cold water is being made with over-great rapidity, and is doing harm, and so warmer water must be used for some time longer. An excellent method of training little children to stand the cold water is at the end of their warm bath to rapidly sponge them with water a little cooler than that of the bath they have had, and then the next day use water at this lower temperature.

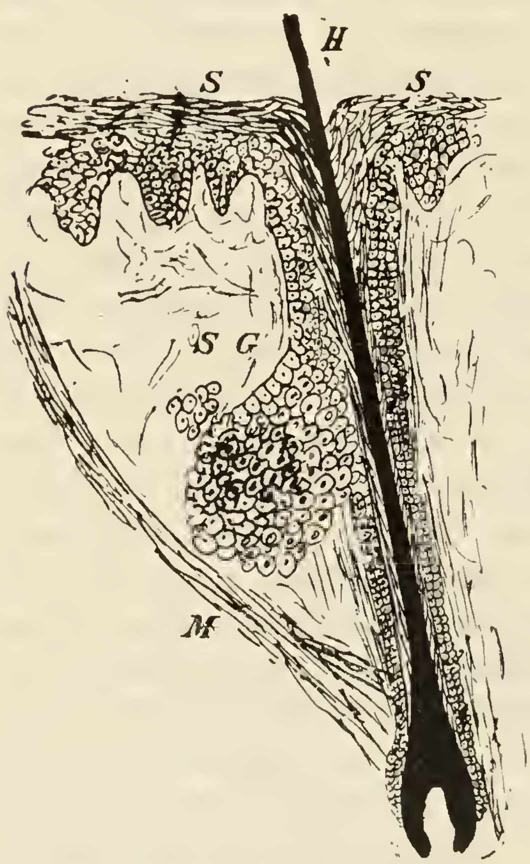

Fig. 34.

The Scalp is a part of the skin frequently ill-used by man. Some cases of ill-use arise from neglect, in many cases from over-attention.

The hairs are deeply embedded in skin. (Fig. 34.) They are supplied with a special muscle (*m*) that has limited power of moving the hair. Hairs have glands related (*sg*) to them which secrete an oily material. This oily matter greases the surface of the skin around the hair and prevents microscopic cracking taking place between the little scales forming the surface layer of the skin and hair bag (SS). Such cracking is likely to occur by movements of the muscles in and attached

to the skin, and so oil glands are found large and numerous where such movements occur freely. Cracks in horny surface layer of skin allow micro-organisms to attack deeper parts, and disease arises. Scurfy heads are a manifestation of such disease.

When the scalp is washed with soap and water, the natural oil is removed. It is necessary to wash the scalp once a week, or dust and organisms collect and do harm. It is better to replace the natural oil by use of pomade after washing the head. This should be applied to the scalp and roots of the hair, not to the hair shafts. The hair should be parted in several places, and a little pomade carefully placed in the partings. Washing the head more frequently than once a week is generally bad, and is a common cause of dandruff and baldness. Brushing and combing the hair must be indulged in moderation. If dandruff exists, each little scale is laden with germs, and these germs are scratched in by hard brushes and soft combs. The upper skin is scratched, and the scratches innoculated. The scurf removed by brushing is thus rapidly reproduced by new innoculations, causing fresh and increased disease. Soft brushes are better than hard, and combs with widely separated blunt teeth better than fine combs. Pulling on the hair increases the necessity for grease on the scalp. The danger of removing the grease by washing is greater than that of leaving it, and so with long hair the weekly wash had better be substituted by a fortnightly one. When hairdressers' and cutters' shops are visited the machine brush should be avoided. It scratches the scalp, and innoculates scurf from one head to another in a very undesirable way. It is always inadvisable to use another person's brushes, etc. Continuous covering of the head with caps, chignons, encourages growth of micro-organisms. The scurf and other germs grow more freely under conditions of warmth, moisture, and darkness. Hats and caps should be ventilated to limit the moisture and heat.

Dandruff, apart from the unpleasant itching it often causes, and its æsthetic inconveniences, is a somewhat serious matter, as it in time leads to baldness; and the organisms causing dandruff are intimately related to those causing eczema and other skin troubles. Patients suffering from dandruff are always in danger of being attacked by other more violent skin diseases.

CHAPTER XX

CLOTHING

Clothing serves man as a means of protection, and for æsthetic purposes.

The following properties should be studied in clothing materials, from a health standpoint :—

(1) Conduction of heat.
(2) Power of stimulating or irritating skin.
(3) Power of absorbing moisture, and porosity to air.
(4) Power of absorbing light and heat rays.

Heat Conduction.—Some substances, when brought in contact with a heated body, rapidly remove its heat and conduct it along their substance. They are called good conductors. Excepting under conditions of great external heat, good conductors when touched by our bodies feel cold : they remove body heat. Linen is a better conductor than wool ; and if on a cold winter's night one turns in between linen sheets the bed feels far colder than it would if the sheets were taken away and wool blankets brought in contact with the skin. Bad conductors of heat are therefore warm clothing materials.

Gases are bad heat conductors ; yet, if the body were exposed unclothed to the atmosphere it would be rapidly chilled. This is the result of *convection currents.* The air in immediate contact with the body is warmed ; it expands and rises, and cold currents of air flow down and take its place. This process continues, and large amounts of heat removed. If convection currents are stopped, air may be made a valuable clothing material. Thus the layers of air between bedclothes form a warm clothing : the bedclothes prevent convection currents. Two thin garments are warmer than a single thick one : there is a layer of imprisoned air between them. Loosely-woven fabrics are warmer than closely-woven ones : air fills the spaces between the fibres, and friction *plus* attraction stops the convection currents.

The power of heat conduction of a clothing material depends upon (1) the substance of which it is composed, and (2) the way it is woven ; loosely-woven materials being worse conductors of heat.

ORDER OF HEAT-CONDUCTING POWER OF DIFFERENT FIBRES

Linen	=	Best conductor	=	Cold clothing.
Cotton	=	Good conductor	=	Cool clothing.
Silk	=	Fairly bad conductor	=	Warm clothing.
Wool	=	Worst conductor	=	Very warm clothing.

Furs, and skins generally, feathers and down, are also bad conductors.

Skin stimulation.—The property is usually objectionable in underclothing. The degree of trouble depends upon the sensitiveness of the individual, and upon the clothing material. The same material may in one individual cause a pleasant stimulation, and in another maddening irritation. The sense of warmth produced by skin stimulation is deceptive. It is due to dilation of surface vessels (pp. 30, 31).

Wool is very stimulating, especially coarse wools; silk is much less so, but much depends on its preparation. Cotton is very slightly stimulating, and flax even less so. Fabrics made with very few loose projecting fibres are less stimulating than those with fluffy surfaces. Some poisonous dyes injuriously irritate skin.

Water absorption.—It is important that underclothing should readily absorb moisture, and pass it through its substance. In this way secretions of skin are not interfered with: evaporation takes place from surface of clothing instead of skin, and too rapid chilling is prevented. Overclothing for protection is better for having less power of absorption. Rain, etc., does not soak and make the clothing wet and heavy; and, moreover, air driven by wind will not so easily penetrate, and so such garments better protect body from external cold. Power of absorbing water is greater in loosely-woven fabrics.

Different fibres vary in their individual power.

Wool readily absorbs moisture.
Silk is less freely absorbent.
Linen absorbs moisture with difficulty.
Cotton fibres absorb badly, and are easily wetted.

Absorption of light and heat rays.—Dark-coloured materials absorb heat and light, and turn light rays into heat easily. So dark overclothing is hot in summer time.

Dark clothing absorbs and retains smells more than light-coloured clothing.

Clothing and garments should be arranged so as to avoid the following defects :—

(1) Interference with free passing away of skin secretions.
(2) Injurious action by friction or pressure.
(3) Interference with natural movements of body.
(4) Upset of heat-regulating power by excessive clothing.
(5) Irregular clothing.

These defects can be well appreciated by studying some common forms of clothing.

Underclothing.—Flannel forms the best material for underclothing. In some cases flannel irritates the skin, and cannot be worn without great discomfort; merino may be tolerated in such cases. If merino also is too irritating, then, as pure silk is too expensive a material for the majority of us to wear, we must choose between flax and cotton. Both cotton and flax, in the form of closely-woven materials, as calico and linen, are cold things to wear, and they do not allow the sweat to pass readily away through them, and so are unsuitable for underclothing. A very good material for this purpose can, however, be made from cotton. This is done by weaving the cotton in a loose cellular manner, so as to leave air spaces between the fibres, a good cheap example of such material is sold under the name of oatmeal cloth or canvas cloth. This conducts heat slowly from the skin, and absorbs moisture fairly well, and does not irritate the skin.

At night underclothing of healthy people should be made of smooth calico or linen. Woollen underclothing is in some cases a cause of restless nights. At night a healthy person does not, or ought not to sweat much. Night sweating indicates either too much clothing or disease.

Patients troubled with chest complaints or rheumatism may require to wear flannel or oatmeal cloth night-dresses, especially if they sweat much at night.

Overcoats and outside clothing for cold windy weather should be made of material through which the wind does not easily blow. Woollen goods, as a rule, are easily blown through; cotton is less porous to the wind. Wool cloth overcoat, lined with smooth stout cotton, is often worn, but as

a warm covering against cold winds it should be worn with the cotton outside. Macintosh is impervious to the wind, but is bad to wear when we are walking or doing much exercise, as it keeps the sweat moisture from passing out. For driving in cold winds macintosh forms one of the best overclothing.

It is a mistake to wear too much clothing. The over-loading, over-coddling of the body with a lot of clothing destroys the natural powers possessed by the body of resisting cold, and the least exposure is followed by ill-results. Some parts of the body that are liable to be exposed to accidental chill and cold—for example, the feet—should be trained by a judicious hardening process to withstand such exposure. Many people, even with good sound organs of circulation, suffer from cold feet, and even slight exposure with wet feet results in a bad cold. The feet habitually swaddled up in wool and leather get tender, the natural protection against cold (partly a muscular mechanism) wastes away from disuse, and becomes useless in times of exposure. Healthy people need not catch cold from wet feet any more than from wet hands. The training must be like all training, gradual and regular. The author has succeeded in curing himself and several other patients suffering from cold feet by the following method : Begin treatment in summer time. Summons up sufficient courage to overcome domestic opposition (especially necessary for married men), and habitually forget to put on shoes and socks until after breakfast. After a while extend the training to a good tramp on dry turf; later on walk barefooted on the dewy grass in early morning. Continue this regularly, and when the winter comes complete the training by walking for a short spell barefooted on the hoar frost or snow-covered grass. Then cold feet during railway journeys, chilblained feet, and coughs and colds from wet feet will be things of the past, providing that the training be kept up at intervals, and that tight foot clothing be always avoided. Of course, such a course of training is only suitable for those under middle age.

Head Clothing.—Avoid heavy head-dress. If a hat with rigid brim is worn it ought to be made to measure. Hats should be ventilated—*i.e.* with proper inlet and outlets. (See pp. 126, 127, and p. 48, etc.). The head should be kept uncovered as much as possible.

Neck Clothing.—The neck should be either always exposed

without any clothing, or else always wrapped up. The habit of occasionally wearing mufflers, etc., at one time and then going without at another, or of generally wearing a high-necked dress and then occasionally a low-necked one, often cause throat and chest troubles. Mufflers, boas, etc., if never worn, are never required. When clothing is worn round the neck it must always be loose. Tight neck clothing is especially dangerous for stout people after middle life: it may favour apoplectic fits. Tight night-dresses are especially dangerous.

The *clothing of the chest* ought to be loose, especially during exercise, when amount of respiration is greater (p. 145). When our soldiers and sailors marched across the desert of the Soudan, the tight uniforms over the soldiers' chests caused a far greater percentage to fall out.

Corsets and Stays.—Young girls should never wear stays, they are only injurious, and lead to a non-development of the natural support of the body, and render the wearing of artificial supports in after-life necessary. Old stout people sometimes require stays, and these should be of some firm material, such as stout jean without bones. All pressure round the waste is injurious to health.

Petticoats are an extravagant, absurd, and almost useless garment. A great weight of clothing has to be carried, and undue thicknesses and constrictions worn round the waist in order to derive a small amount of warmth.

Petticoats ought to be replaced by knickerbockers loosely fastened by buttons or buckled below the knee, and these may then be covered with a skirt, and if necessary to make it sit well, a short petticoat of silk or some other material.

Garters tightly constricting the thigh above, or the leg below the knee, must not be worn. Anyone who suffers or has any relations suffering in any way with enlarged or varicose veins, must be most careful to avoid garters. Suspenders are better than garters, but these may, with advantage be done away with if our legs are well developed by exercise, so that the calf will keep the stocking in its place.

Trousers are, as a rule, better than knickerbockers, as with garters anyone with a tendency in the family to the formation of varicose (swollen and knotted) veins, had better avoid altogether the wearing of knickerbockers. In such cases cyclists had better wear the old-fashioned peg-top trousers.

The bad effects of knickers are accentuated by the sitting posture with the legs bent at the knees.

Socks are better than stockings for the above reasons. The socks ought not to be worn with pointed toes. The toe should be more square-shaped or slightly slanted off towards the outer side.

Boots ought to be made to fit the foot. The measurement of the sole should be taken when standing up with the foot firmly implanted on the ground. This can be done by making a tracing of the outline of the foot on paper. Pointed-toed, high-heeled, and tight boots are the principal causes of corns, bunions, and disabling deformities of the foot. The sole ought to be as flexible as possible, the heel far back, and never more than $\frac{3}{4}$-inch high. Lace-up boots are better than elastic sides, especially for those who have a family history of varicose veins.

Beds and Bedding.—Metal bedsteads are better than wood. Curtain hangings round the bed are bad. Bedsteads should be easily moved, and so ought to have good castors. The entire floor of a bedroom should be cleaned thoroughly at least once a week; this cleaning must include the space under the bed; for this and other reasons the bed must not be made, as it often is, a cover for the lumber of the household.

Spring mattresses of twisted uncovered wires, are by far the best kind for health. On this spring base a good thin horse-hair mattress should be placed, and, if preferred, there is no great objection to placing over this a feather bed. Patients liable to asthma cannot always stand feather beds and pillows. Feathers give out a little fine dust, not enough to do harm to healthy tissues, but enough to cause asthma in some susceptible people, and to do harm sometimes to people who, in consequence of obstruction of the nose, sleep with their mouths open. Air pillows or good horsehair stuffed pillows are the best substitute for feathers in these cases.

The covering bedclothes should not be heavier than is absolutely necessary for proper warmth. Bedclothes must be properly aired. When we get up in the morning the bedclothes should be taken off, one by one, and spread out, so that fresh air can circulate through them, and they should be left spread out in this way in fine weather, with the window wide open, for at least two hours. The idea that airing the beds consists in sleeping in them is absurd. Sleeping in the bed merely

uses up the good air in the bed, and passes into its place damp foul gases from the skins of those sleeping in them. Colds and various lung, skin, and infectious diseases are frequently spread by bedclothes.

Clothing for Babies.—A little dusting powder is required next the skin (see page 126). A flannel binder round the abdomen should be worn. It must never be bound tightly, but ought to be merely wrapped gently round the waist. Napkins, when worn, must never be covered by a waterproof. A shirt of fine lawn may be worn and then a good flannel gown over all. Should any further clothing be required, a good worsted or flannel shawl forms one of the best garments. Napkins must be removed directly they are wet, and must be washed well and thoroughly dried before they are used again. The dirty practice of merely drying a wet napkin and again applying it without washing is not only obnoxious for our sense of smell, but is also distinctly injurious to the child. An infant's clothing must not be tight anywhere. Serious mistakes are continually made by having tight sleeves and tight strings round the neck and waist.

Young children are more liable to damage from deficient clothing than adults. There are two great reasons for this, first, children have a relatively larger surface to be chilled; second, inefficient clothing necessitates using up of food to produce warmth instead of promoting growth and development. The full growth and development of body and, to a less degree, of mind, are checked by deficient clothing. In after-life this check may never be made up. It is equally bad to put excess of clothing on a child. In this case development of heat-regulating power is weakened and child becomes liable to chills, etc. The over-swaddled child cannot take proper exercise, and this checks development (p. 147). Contrary to many authorities the author believes in training young children to do without stockings and boots or shoes. Short trousers coming nearly down to the ankles and sandals are far better clothing for young children.

CHAPTER XXI

THE EAR AND HEARING

Some people are very fond of picking their ears with pencils, pens, straws, etc. This practice is very dangerous. Injuries to the ear drum, abscesses, and other serious troubles are often caused by ear picking.

It is often considered dangerous to stop a discharge from the the ear. This is quite true if attempts are made to stop it by plugging up the ear with wool, etc. It is, however, quite wrong to suppose that harm may be done by treating the ear in a proper way to remove the cause of the discharge, and so stop it. Continued discharge from the ear is often caused by disease deep down, and if neglected may lead to serious and perhaps fatal disease of the brain, and on this account it must never be allowed to go on without proper and skilful treatment. Ear discharge may continue for years, but sooner or later alarming symptoms may arise, and then often the patient goes to the doctor, but is too late. Many lives have been lost through neglect in cases of ear discharge.

Cold water in the ear does harm. The harm done is greater in the case of sea water. When bathing, especially if diving is practised, the ear should be gently plugged with a little cotton wool; it is well to oil the wool with a little almond or olive oil before using it. The wool should be removed directly the bath is over, and the ear gently dried with a soft towel. In drying the ear, the head should be bent down towards the side to be dried. The practice of twisting a corner of a cloth down into the ear is bad. The towel placed over top of a finger should be pressed gently against the external opening of the ear canal. These precautions against cold water entering the ear are especially important for those who have previously suffered from ear troubles.

Children occasionally get small pebbles or peas into their ears. Attempts should on no account whatever be made to extract them by means of hair-pins or other solid bodies. Very serious and often dangerous injuries are frequently inflicted on the drum and other parts by such attempts. Foreign bodies remaining a short time in the ear, if left alone, do but little

harm ; the harm arises from unskilful attempts to extract them. They are nearly always removable with the greatest ease by syringing out the ear with warm water. Peas and other bodies that soak up water and swell should always be syringed out by a doctor, for if the syringing fails other surgical means must be adopted to remove them before they have time to swell.

Insects in the ear occasionally cause great irritation. They are generally easily removed by syringing with warm water. If an ear syringe is not at hand, a little warm olive oil poured into the ear will get rid of the trouble.

The popular idea that all cases of deafness can be improved by syringing is not correct. Syringing does harm in more cases than it does good, and so in all cases of deafness the ear should be examined by the doctor before any such attempt is made to relieve it.

Drops and other applications to the ear that are of use in some kinds of disease and deafness may cause great destruction and often permanent damage if used in other cases. On this account ear drops must never be used by anyone simply because they have heard that another person has benefited by their use.

The nasal douche with a head of water should never be used without medical advice and supervision.

Teachers, parents, and others may be guilty of causing grievous, and perhaps fatal, injury to children when they adopt the abominably cruel practice of boxing ears.

Whenever a child is markedly inattentive, care should be taken to ascertain whether the child is suffering from deafness.

Singing and other noises arising in the head and persisting for some time should always lead the sufferer to have the ears attended to, and he may then be saved from what may cause permanent deafness.

The habit of continually wearing wool in the ear is injurious. It makes the ear passage delicate, and causes great liability to ear-ache and other troubles.

Tight bonnet or cap strings pressing on or close behind the ear must be avoided, they are sometimes a cause of deafness.

Ear-rings, if worn, must never be made of metals other than gold. Serious blood diseases have been set up by the operation of making a hole through the lobe of the ear with unclean instruments.

There is a form of deafness in children associated with a growth in the top of the throat behind the nose. Children with this affection are not only deaf, but are often incapable of fixing their attention upon study or anything else. The nose is obstructed, speech is peculiar, the child sleeps and goes about with mouth constantly open, and snores a good deal at night: it is liable to throat trouble and asthma. Any such symptoms should cause parents to have the child medically examined. A comparatively slight and safe operation will remove the growth, improve the child's intelligence and appearance in a wonderful manner, make it heartier, stronger, prevent more or less serious deafness, and perhaps save it from a consumptive's grave.

CHAPTER XXII

THE EYE AND SIGHT

Long Sight.—Sometimes a child on beginning to read, write, sew, or, in fact, do any work that requires close looking at, very soon turns from its task, and declines to do any more. If this child is pressed and forced to work, headache, pain, etc., in the eye are often experienced, and the child looks forward with terror to its work. Continued forcing the child to work makes matters steadily worse, and all kinds of troubles, from aching head and eyes, and squinting, up to severe nerve troubles, such as convulsions, etc., may arise. The early symptoms in such cases are often put down by the parents to indolence or perverseness on the part of the child, when in reality the poor child is suffering severely in consequence of its eyes being peculiarly formed, so that they are long-sighted, and therefore cannot see near objects clearly without severe, painful, and very damaging strain. Children showing such unnatural dislike to work, etc. ought always to have their eyes examined by a surgeon, and then, if long-sighted, to get proper spectacles, in order that all these troubles and dangers may be removed.

Short Sight.—This condition is developed after birth. Children of short-sighted parents more easily develop it than

others, and so such children must be more careful in avoiding the causes that give rise to short sight. The principal causes are as follow :—

(1) Prolonged use of the eyes in looking at near objects.
(2) Insufficient light for work or light badly arranged.—When engaged in reading or writing we should always try to have the light coming from the side, and, in preference, from the left side. A cross light from each side is not, as is commonly supposed, injurious. The worst direction for light to come from is directly from the front. Reading or writing with the face to the window, fire, or other light, if practised for any length of time, is injurious to the sight.

N.B.—It is of great importance that at school the desks, etc. should be arranged so that the child can read and write with comfort, and in the way best suited for the preservation of sight. The slope of the desk for reading should be at an angle of 45 deg., and for writing 35 deg. The edge of the desk should never be more than one inch in front of the edge of the seat, and the right height for it to be above the seat is one-sixth part of the child's height. The height of the seat above the ground should never on any account be more than the length of the child's leg, measured from the sole of the foot to the knee. Too narrow seats ought to be avoided; they had better be at least eight inches wide. A support for the back ought to be attached to the seat. Such precautions as these not only help to prevent short sight, but also curvature of the spine.

(3) Reading books printed with very small letters, especially if printed with two or three columns to the page, also reading much small type in long lines, as in above note.
(4) Reading books badly printed on rough coarse paper.
(5) Any great amount of reading, writing, sewing, or any such close work in badly-fed and poorly nourished children.

Old Sight.—Changes gradually take place in the sight with advancing age. Near objects are seen less distinctly, ordinary print becomes difficult to read unless held a long way from the eyes, threading the eye of a needle becomes almost impossible; colours, etc., are often distinguished less clearly. In such cases the aid of spectacles must be obtained. It is a great mistake to imagine that the sight may be preserved by delaying the time of taking to spectacles after old-age difficulties in sight

are experienced. Any such delay involves a strain upon the eyes, and this extra strain only makes matters worse, and increases the troubles of old sight. The sight is preserved by wearing spectacles when these are felt to be required. The exact age when spectacles are required for old sight varies very much in different people.

Old people should also do as much as possible of their reading, sewing, etc., in the daylight, and not attempt it at all at night unless they can have the room very well lighted. Sewing of black cloth, etc., should be avoided, and so also should reading and work in close, hot rooms. Any work involving strain on the eyes must be avoided after meals in such cases.

Inflammation of edge of eyelids in children is a disease that should not be neglected. The lids are red, sticky matter mats lashes together, and the lids are stuck to each other during sleep. Neglect leads to ulceration, permanent destruction of the lashes, weakening of sight, and permanent disfigurement results. Prompt and proper treatment by a surgeon, and improving cleanliness, feeding, etc. of the child will generally effect a cure.

Dirt, bad air, and bad diet, at times, lead to ulceration of the front of eye in delicate children. Such children are generally terribly afraid to face the light, etc. It should be promptly treated, or opacities, and sometimes severe destructive changes on the eye result.

Styes.—Crops of styes are sometimes the results of general bad health and anæmia. Change of air, generous diet, and free outdoor exercise will often remove the trouble.

Amateur doctoring by quacks and old women of both sexes is responsible for a good deal of eye trouble. Often the terms "weak eyes," "inflamed eyes," are the cause of a great deal of this folly. The practically meaningless term, "weak eyes," is vaguely applied to any of the huge number of eye affections. Patients having heard of a remedy used by someone for some disease of eye or accessory apparatus termed "weak eyes," and who may be suffering from a very different disease, perhaps not of the eyes at all, or from no disease whatever, but who have come to the conclusion that they suffer from "weak eyes," go and apply the substance they have heard of and perhaps do themselves serious harm. The author knows certain human

beings, otherwise intelligent, who chronically irritate their eyes by squeezing the juice of orange peel into them. They had heard that it strengthened weak eyes, and no arguments could convince them of the absurdity of their procedure.

Inflammation of the eye is of various kinds and stages, and differs as it attacks different structures and parts of the eye. Remedies suitable for one kind and one place are often very damaging to another.

Poultices applied to the eyes have often caused most disastrous trouble. There are a few cases of eye disease relieved by short application of hot poultices, but there are far more cases in which these do harm. The greatest harm results from the frequent or prolonged application.

Cold tea is useful in a few cases, especially of lid trouble, but does harm in others. When applied constantly on cloths, etc., it is almost always injurious, especially if covered with oiled silk.

Sulphate of Zinc is a cheap drug, and a pennyworth varies, according to the druggist, from a few grains to many hundreds; consequently, the popular way of getting a pennyworth and dissolving it in water may mean the use of a strong solution. Such solutions are most injurious in all cases. Some few inflammatory diseases are in certain stages benefited by a weak solution, but far more are injured.

Lead lotions are most injurious when indiscriminately used. In surface ulcers they cause opaque deposits, and result often in defects of vision, sometimes blindness. Small surface ulcers of the eyeball are difficult to see, and often require special illumination skilfully made for their detection.

Binding up the eyes prolongs and increases many surface inflammations.

Foreign bodies in the Eye.—The effects and treatment of outside bodies getting into the eyes vary according to the substance and the way in which it enters; there are four common accidents of this kind:

(1) Where a blunt body gets on the eye and does not penetrate or stick in its coats.

(2) Where a sharp body strikes the eyeball with sufficient force to wound the outer coats of the eye and to stick in the wound. Sometimes such bodies

completely penetrate the eyeball and remain inside. The latter accident is extremely dangerous; both must be attended to without delay.

(3) Where chemically active bodies enter the eye and do damage by their caustic irritating properties.

(4) Where hot bodies enter and burn the surface of the eye.

The first form of accident is extremely common. It frequently occurs in railway journeys, when a bit of cinder is usually the offender. When this happens, the sufferer often starts rubbing the eyes and only succeeds in doing harm by scratching the surface of the eyeball. The first thing to do in such an accident is to seize the eyelash and edge of the upper eyelid with the forefinger and thumb of the hand of the same side as the suffering eye, and with them pull the lid away from the eyeball and then vigorously blow the nose. If this fails to wash out the irritant, then pull the upper lid over the lower, and, as a rule, this will remove the offender. If this latter expedient does not succeed, then the aid of a second person must be obtained. Perhaps he may see the foreign body, and easily remove it with the twisted end of a handkerchief, or, if at hand, a bit of dry clean blotting paper. If this cannot be done the upper lid should be turned inside out. This little operation is easily performed. A long stick, like a lead pencil, is held against the upper lid, parallel with its edge and about half-an-inch above it. The edge of the eyelid is grasped with the forefinger and thumb, and the patient, without moving the head, looks down, and as the eyeball moves downward the operator quickly turns the lid upwards over the pencil. The foreign body is then generally seen on the red under-surface of the lid, and can be removed with the handkerchief. If it is not easily seen, the under surface of the lid should be smoothly and gently wiped over with the tip of the finger, covered with the fold of the handkerchief. If all these manœuvres fail, and the eye is still painful, the aid of a surgeon should be sought as early as possible.

Insects in the eye act partly as loose foreign bodies and partly from chemical irritation.

When the eyeball is wounded by a chip of stone or steel,

or a bit of percussion cap, as occasionally occurs when children are allowed to play the dangerous game of exploding such caps by beating them on a stone, or by a fork, etc. skilled surgical aid must be sought as early as possible.

When chemical irritants or hot scalding matter get into the eye a surgeon must immediately be sent for; pending his arrival various treatments may be adopted, as in the following cases:—

Quicklime in the eye.

(1) Wash the eye out freely with some water in which a little sugar is dissolved, then insert under the lid as soon as possible some weak vinegar and water, about a small teaspoonful of vinegar to a good half wineglass of water, this should be followed by freely washing the eye with water and then pouring in a few drops of olive oil.

Strong potash in the eye.—This should be treated as soon as possible by the insertion of a little of the vinegar and water solution under the lids, and followed by free washing of the eyeball with plenty of water, and then the application of sweet oil.

Strong acids in the eye.—(Spirits of salts, oil of vitriol, etc.)

(2) Wash the eye with a weak solution of bicarbonate of soda—5-10 grains in a wineglass of water*—or with some soap and water. Then pour in some sweet oil.

If the above solutions are not at hand for any of the above cases, then no delay should be made in washing the eyeball with plenty of water. Apply the water with a small syringe, or if a syringe is not obtainable, lay the patient on his back, hold the eyelids open, and pour the water on the eyeball out of a kettle or any such spouted instrument.†

Burns and scalds.—These accidents, fortunately, are rare, the eyelids guarding by rapid movements the eyeball.

A little sweet oil should be put in the eye as soon as possible.

Light.—Bright white light is a necessity for vigorous health. Sunlight is a great stimulator of vitality. Children living shut

* About half an egg-spoonful to the gill (¼ pint).

† In factories and places where these accidents are liable to occur, an eye douche should be ready, and a supply of distilled water.

up in dark rooms with only dark slums, courts, and alleys for their occasional outing, soon become the objects of disease. Rickets is especially likely to develop in the very young, and all sorts of painful affections and dreadful deformities may arise in consequence. Gas light, and, in fact, all sorts of artificial light, excepting, perhaps, the electric light, are wanting in this power of stimulating health and vitality.

Bright white light also has a great power of purifying the air.

A dwelling is therefore always more healthy in proportion to the amount of sky that is visible from all parts of the room.

If a room is badly lighted, either from it having too small windows, or in consequence of the height of houses shutting it in, or narrowness of streets, etc.—and these faults cannot be remedied—the walls of the room should be made as white as possible, and all furniture, etc., in the room had better be light in colour. In this way the light that enters the room is economised, and the best made of a bad job.

CHAPTER XXIII

EXERCISE

Proper exercise of both body and mind is absolutely necessary for health and reason. Exercise must be general, all parts of the body require it, and therefore we must not be contented with work of one special kind, but must vary it in order to bring into play all parts of our bodies and brains.

The muscles of our body are under control of the nervous system, and the great centre of action of the nervous system is the brain. It is therefore impossible for a man to exercise his muscular system without at the same time giving his brain some work to do. In the exercise of what we term mere brute strength the brain exercise is very limited, and in order to keep ourselves in the position of healthy, rational individuals, other mental exercise must be added.

Great muscular growth and development is possible with proper exercise. Not only does the power increase, but the work is done more rapidly and easily.

Each manifestation of life is an indication of death. When we use a muscle part of it dies, is removed, and in the properly working body new material is brought to repair, regenerate, and replace the lost tissue. A new broom sweeps clean. A new muscular fibre contracts, and does its work better than an old dormant one. Not only is the used muscle renewed, but judicious exercise by a healthy man is also capable of increasing the size and number of muscular fibres, and thereby the power of the entire muscle.

The importance of bodily exercise was recognised by the ancients. In the old Roman era, feats of bodily vigour were the ideal of their games, they were encouraged in every way by those in authority and by the nation. The grand old Norsemen, the kings of the ancient seas, prized above all things bodily exercises and training that led to the highest possible muscular vigour. Those old days were the times when might was right, and physical strength was might. Nowadays, although we do not recognise as a principle that might is right, nevertheless might still rules the world.

Mighty men rise and guide and rule us. Some rule and guide us in the daily work of our lives by their researches into the ways for the application of the forces and energy of nature, showing us new, easier, and perhaps better ways of living.

Others by the study of our social system, of the ways and means of guiding the movements of communities and the natures of men, and by their knowledge of the working and weaknesses of the minds of individuals, acquire great political and social power, and govern all things. But the power of such men does not so much lie in their muscles as in the power and clearness of their mental organs. Consequently, the exercise now required by men who wish to acquire wealth or power is brain work. No more deadly and grievous mistake, however, can be made than that so often done by enthusiastic students—*i.e.* to exercise their brains and exclude proper bodily exercise. Such procedure means all-round failure, disease, and death.

Men with big chests and large lungs—men who during school life have been athletes—on going to the university, and working unwisely, or to other work necessitating exclusively sedentary indoor life, frequently fall victims to disease. Such men require more vigorous outdoor exercise than puny, small-chested individuals; their large lungs require violent exercise

to change the air thoroughly. If they suddenly give up their outdoor exercise, and devote themselves exclusively to indoor work, unhealthy processes start in the unused parts of their lungs, and form a site for tubercular disease. Many strong, healthy men are in this way hurried down to a consumptive's grave.

Physiology of Exercise

Effects of Proper Outdoor Exercise	Immediate.	Increases force and rapidity of heart's action.
		Increases respiratory functions (amount and rapidity).
		Increases appetite for food.
		Increases action of skin.
		Increases waste and repair in muscles, brain, and other tissues.
	Ultimate.	Increases size and power of muscles.
		Educates the mind.
		Develops the brain.
		Leads to vigorous health.

The pressure of contracting muscles upon the blood-vessel sends back the blood at a more rapid rate to the heart. So also do the increased depth and rapidity of the respirations. This increased flow of blood into the heart stimulates it to contract more rapidly and with greater force. Exercise of the heart, like exercise of other muscles, stimulates its growth, and it becomes more powerful.

This using up of muscle means increased production of waste products, and increased amount of gaseous, solid, and liquid food required. The skin, lungs, and kidneys have more waste matter to eliminate. Increased respiration and increased action of the skin and other eliminating glands occur, and if the exercise is properly regulated the increased functional activity of these organs causes increased vital strength, and thus a greater power of resisting disease. The increased respirations increase the supply of oxygen, increased appetite causes more solid food to be taken. Increased thirst causes water to be drunk freely, and this helps the solution of the food matter, and enables the waste products in the various muscles to be washed out and carried to the excreting glands more easily. Early removal of these waste products diminishes fatigue and increases the

powers of repair and growth. On this account we require to drink freely of water when employing heavy muscular power.

Muscular activity and muscular growth are accompanied by growth of the bones and stronger development of the joints. Thus an athlete is less liable to injure these structures than a feeble individual.

Undue or excessively violent exercise may cause various accidents and ill-results, thus—

Muscles may be torn through or ripped from their attachment to the bones. The bones themselves may at times be broken.

Curvature of the spine may be set up by prolonged fatigue, such as is sometimes thrown in the muscles of the back in a young girl from sitting on unsuitable forms at school. A schoolgirl who lolls and complains of backache should be carefully treated with properly-regulated exercises and rests.

Excessive strain may rupture blood-vessels, or even the heart itself.

Prolonged regular use of certain muscles in one special way for very long periods of time may set up disease of the nervous system, giving rise to the phenomena of writers' cramp, and such like troubles. Telegraph operators, for example, are liable to this disease.

Ruptures of the abdominal walls, and protrusion of its contents may happen and disable the unfortunate patient, and perhaps cause fatal trouble.

Varicose veins may be exaggerated by unsuitable or excessive exercise.

Lung disease may be set up in consequence of the strain on the lung from the violent inspiratory efforts during excessive bodily exertion.

General fever, and fever occasionally of a fatal character, may be started.

Exercise ought not to be continued when distressful or painful breathlessness comes on. It may be modified so as to relieve this; if it cannot it should be stopped.

Breathlessness pressed until some lividity of the countenance is developed is a dangerous thing. With training and economic use of muscles, both of respiration and other movements, and with good health, breathlessness need not occur with a rational amount of exercise. If it cannot be overcome it

probably indicates disease, and medical advice should be sought. Of course, any man can easily lose his wind by undue exercise, no matter how perfect his health may be.

Those unaccustomed to bodily exercise always require a steady course of training before they attempt great things: walking and hill-climbing of light character are perhaps the best beginnings.

Exercise in infancy and early childhood.—Exercise of all muscles is necessary from birth. The little infant in its cradle, or on its mother's knee, is during his wakeful hours exercising its muscles in all sorts of ways. It is continually kicking out its legs, doubling up its fists, and striking out like a young prize fighter; then to exercise its abdominal and back muscles, it proceeds to put its feet in its mouth, and squirm, coil up in all sorts of fidgety and extraordinary ways. Mothers often attempt by tightly tucking down the clothes, by long gowns, etc., to limit these infantile fidgets; they do a great wrong to the child by such interference with Nature's work. These movements of the infant are necessary for the proper growth and development of its frame; check them, and not only will the child's present health and temper suffer, but it grows up in after-life a feebler and punier adult than otherwise it would have been. As time goes on the infant frame is prepared for locomotory efforts. Naturally, it rolls before it crawls, and crawls before it walks, just as its more remote ancestors crawled and crept before a race appeared who adopted the erect attitude. Mothers frequently try to unduly hasten on the processes of Nature, and in their pride of offspring try to make it break the record in early walking. Attempts to make the child feel its feet, and support its weight too soon, are apt to do considerable harm. At birth the upper part of the infant body is developed relatively much more than the lower. Its body is for a long time too heavy for its legs, and if the latter are made to support this excessive load their still soft bones are liable to yield, and deformities result. A child left to itself soon finds its way into the erect attitude when the time comes for it to adopt this position. Don't be afraid of soiled dresses, etc., but encourage the child to crawl when it will, and when fit it will walk.

The average rate of muscular development is as follows:—
Head held up at end of third month; infant can adopt sitting

position at end of fourth month; it crawls about at end of eighth month; pulls itself by supports into the erect attitude at ninth to tenth month; may walk with assistance about the eleventh month; and about the fourteenth month may walk a little without aid.

After the child can walk it is well to encourage the playing of simple games, so that not only the muscles, but the powers of reason may be better developed. Up to the speaking period of life an infant's brain has much to do in observing the world around and making deductions from these observations. Such observing powers in a young child are very great, but later on there comes a period when the palpably visible universe becomes familiar, and then, unless the child's early powers of observation are encouraged and stimulated, they are apt to rust, and the greatest powers of the mind are not fully developed in consequence.

Games and exercises that bring uniformly and regularly all parts of the body into play are the best. All muscles should be used regularly, especially in the early time of life when all are capable of great growth. In this way bowling a hoop is a most useful adjunct to the child's walk.

Between the ages of twelve and eighteen is a period when mistakes are often made in regard to bodily exercise. It is a period of life when great changes are going on in the body. Maturity is approaching, great growth and development are going on, and a strain is put upon the system. At this period of life unnecessary and great strains should be avoided, or the natural growth and development may be checked, and may afterwards be made up. Football contests with seniors, training for races, and such competitive sports should not be attempted; but, at the same time, care must be taken not to go to the other extreme. Regular exercise is very necessary, and it must be of a kind to interest the youth. Cricket, tennis, riding, swimming, skating are good examples of the sort of exercises of great value. Great mistakes are often made at this period in over-pressing girls at school work. The school work should be slackened, and a far greater time allowed for free outdoor exercise than is usually permitted at girls' schools. If this is not done development is frequently checked, and weakness in after-life results.

From the eighteenth year on to about the thirtieth is the period

for vigorous exercise. Then all athletic competitions, races, football, etc., should be indulged in, and the more heartily they are taken up the better the individual becomes.

After the thirtieth year, in the majority of mankind, a period of life is reached in which sudden, violent, or excessively severe exercise must be modified. The vascular system is getting middle-aged, the perfect quality in the elasticity of the blood-vessels is becoming impaired, and their rupture may follow violent strain. Football had better be given up, and so also any other form of exercise in which the muscular power of the body is strained to its full extent for a prolonged period, and cricket, golf, tennis, boating (not racing) should take the place of the more violent strain.

These backward processes in the blood-vessels are progressive. Regular good outdoor exercise delays them, and all adults should take sufficient outdoor exercise in order to keep their vascular system from getting old too quickly. They should make a practice of getting daily outdoor exercise of an amount equivalent to a nine-miles' walk along a level road. The exercise keeps in training the muscular system, including the circulating apparatus, and the amount of fresh oxygen taken into body helps to prevent degenerative fatty alterations that are the starting-point of the old age changes in the blood-vessels.

When old age is reached exercise is still necessary. It must, however, be gentle and regular. All haste and hurry must be avoided. If old people are late for a train, they must not run to catch it; they should take a cab, or miss it. The old man is generally young compared to his blood-vessels; they are almost always the oldest part about him. Strain may rupture them with the greatest ease. Such rupture often occurs in the skull, and apoplexy, with sudden death or paralysis, results. There is, I think, no more alarming sight in the world than to see a stout old lady running wildly after an omnibus, puffing and panting as she runs, with her pulse throbbing and beating, and her arteries strained nearly to the point of rupture. Anyone who knows what is going on inside that old lady looks on in dread, expecting every second to see her drop in an apoplectic fit. Still, while avoiding all such violent exercise, old people should never give up their daily walk until the very last, when their strength is quite gone and the end near.

Mental Exercise.—Mental exercise, like muscular, must be varied, especially in early life, when the brain has great powers of growth.

Different parts of the brain have different functions. These require exercise, in order that they may attain full and healthy power. Variety of brain exercise is especially necessary in childhood. One-sided work may then produce a genius, but it more frequently produces an ill-balanced mind.

Regularity of time for mental work is most important. The brain turns to its work naturally at the regular time for its work, and the work is done better, more easily, and with greater enjoyment to the worker (p. 6). After work, rest is required, in order to recreate the used-up tissues.*

Our play-time must be recreative. In order to be so, it must be spent in play that is opposite in character to our daily work, and it should be pleasurable.

*Over-work in school life is often serious in its results. The power of a young child to concentrate attention on one subject is limited. Chadwick gave the following figures as this limit:—5-7 years of age, limit = 15 minutes; 7-10 years, limit = 20 minutes; 10-12 years, limit = 25 minutes; 16-18 years, limit = 30 minutes. The total amount of school work should be scattered over the day, so as to allow regular intervals for recreation; and daily limit of work ought to be, for 7-8 year old child, 2½-3 hours; 8-10 year old, 3-3½ hours; 10-12 years, 4 hours; 12-15 year old, 5-6 hours; 15 to 18 years, the maximum should be 8 hours. In girls, it may sometimes be advisable to further limit the work between the eleventh and fifteenth years. School children should always have a substantial luncheon, and should not be allowed money to buy it themselves—a child's selection at a tuck shop is not usually a suitable diet for work. The work after noon should be lighter than that in forenoon, and evening tasks should be avoided, especially in nervous children. The growth of all children should be watched; when a child is born a note-book should be started, in which all data of height and weight should be entered. Stoppage of growth may indicate (1) food or clothing not enough; (2) excessive school work and not enough outdoor play; (3) onset of disease. Average growth of infants is given on p. 120. Average growth of boy and girl children is given below in inches:

Age.	Boy.	Girl.	Age.	Boy.	Girl.	Age.	Boy.	Girl.	Age.	Boy.	Girl.
						11-12 yrs.	1·78	2·46			
5-6 yrs.	2·18	2·06	8-9 yrs.	1·93	1·79	12-13 ,,	2·10	2·28	15-16 yrs.	2·70	0·49
6-7 ,,	1·99	2·17	9-10 ,,	1·99	1·97	13-14 ,,	2·67	1·78	16-17 ,,	1·16	0·33
7-8 ,,	2·02	2·06	10-11 ,,	1·65	2·08	14-15 ,,	2·42	1·16	17-18 ,,	0·50	0·03

Any excessive growth should cause the school work of child to be slackened.

Sometimes very sad mistakes are made in this way. Thus, it is not an uncommon thing to see a man whose ordinary vocation requires severe mental work, spending his spare time in playing chess. Chess is a game involving considerable mental work of a varied character, and, as such, is utterly unfit for the recreation of a brain-worker. It is destructive, not recreative. Suicide would be another word for such occupation, and in my short personal experience, I know of many men who have lost life and reason in consequence of playing chess.

A navvy, or any man whose daily work consists of bodily labour without much mental work, may indulge in chess as an ideal game for the play-time. By it powers are brought into work, parts of the body are exercised that otherwise might be left to rust and degenerate. The chess and whist competitions that are becoming so marked a feature in village life in agricultural districts are a grand development, and will probably be productive of very good fruit in the coming generations.

Round games at cards are useful as indoor recreation, involving social jollity and good fellowship, if the gambling element is kept out.

Music is good for all. Its right effect is to soothe the mind and make a man wish for better things, and to be a better man.

The Drama as a mental recreation is invaluable. It is an easy means of diverting the busy worried mind from the present and its surroundings. The dramatic instinct of man is very powerful, and it is manifest at a very early age. Little children in their play act and mimic what they hear, know, and see. All powerful instincts, if properly satisfied, may be made great moral and mental training; if badly used, the result would be correspondingly disastrous.

Forms of Bodily Recreative Exercises

Walking.—A walk with an object is an admirable form of exercise. A mere dull uninteresting walk, taken as a constitutional, does not fulfil the true function of a walk. A walk should be exhilarating and refreshing to the mind in order to do good. On this account those who have taken up as a hobby the study of botany, natural history, or geology, and go in for collecting specimens relating to their hobby, derive great benefits. To them a walk anywhere is a matter of interest.

Each budding flower, blade of grass, every form of animal life they meet, or every stone, rock, cutting, water stream, hill, valley, or plain they pass are matters of intense interest. In this way they obtain the maximum amount of value from even a solitary walk.

The chief muscles employed in walking are the respiratory, the heart, the muscles of the legs, loin, back, neck, and abdomen. The arm muscles are not fully used, and thus those who rely on walking for their physical exercise should add to it some form of muscular work for their arm muscles. Dumb-bells, Indian clubs, bowling, billiards, boxing, fencing, digging, and other such exercises might be practised.

Stout people who find themselves getting very short-winded will generally derive benefit from judicious walking exercise. If possible they should choose for the exercise a hill with a gentle slope. The starting point of the exercise should be the foot of the hill, and it should be slowly ascended until the breathing becomes short, then relief will be felt by the comparative ease of the termination of the walk down hill. Unless there is very serious heart trouble this exercise should be taken regularly, and it will be found that the ascent becomes easier and easier each time it is attempted, and the point reached before breathlessness comes on will be successively higher. By such training dangerous fatty changes in the heart may sometimes be avoided. Each extra foot ascended without breathlessness represents a considerable prolongation of life expectation.

Shooting and Golf.—Cross-country shooting with a fairly heavy gun, or a game at golf, are excellent exercises. All the benefits of walking with an interesting purpose, combined with exercise for the arms, are derived from them. For middle and advancing age golf is an ideal game.

Running exercises more muscles than walking. Practically all muscles of the body are brought into play in very rapid succession. Consequently, running involves a somewhat sudden strain on the circulatory apparatus, and is thus to be avoided by the aged. Running is the most natural form of exercise for young children, and hence the popularity of hoop bowling in our childhood days. Between the ages of eighteen and thirty years long runs are excellent for the healthy, and so paper chases, etc., should be encouraged at this period.

Jumping.—Long and high jumps involve severe exercise of all the muscles of the body. For boys and young men jumping is a good exercise. For girls after fourteen years of age, and men after thirty years it is injurious.

Skipping.—An excellent exercise, especially for young girls. it strengthens the ankle, arch of the foot, and back. The heart and lungs are fairly and well exercised, and the muscles of the legs, arms, back, loin, and abdomen are all brought into use.

Skating.—Better, more thorough, and more extensive exercise than walking. The ankles and back are strengthened, the muscles of the legs, back, neck, loins, and abdomen well used. The healthful stimulation of nerves generally, of the heart and respiratory muscles is increased by freshness of the frosty air.

Horse Riding.—Exercise, both passive and active, is experienced in horse riding. The muscles of the inner side of the thigh and the back and arms are actively used.

The jolting, etc., cause in a passive way, movements of other muscles—*e.g.* abdominal muscles. The viscera inside the abdomen are to a certain extent pressed on, and some conditions of the liver are frequently relieved by riding.

Riding ought always to be learnt when young, and should be carefully taught.

Riding had better be avoided by those delicate children who are said to have overgrown their strength ; also by girls with a tendency to weak backs, or any sign of curvature of the spine, and by those suffering from rupture.

Sculling.—This is not only one of the most popular, but is also one of the very best forms of exercise we can take. Practically every muscle of the body is exercised by proper sculling. It should be well taught, and, with training, may be indulged in without fear by young and old, and by men and women.

Sculling is a far better form of exercise than either canoeing or punting.

Swimming.—Many muscles are exercised, including those of

(*a*) The arms, especially the shoulders.
(*b*) The legs, which are well exercised.
(*c*) The back, loin, and abdomen not very well exercised.
(*d*) The neck muscles well exercised.

The breast stroke is the best form of swimming, as regards the manner of exercise.

Swimming should be avoided

(1) After other violent exercise, and during fatigue of any kind.
(2) Directly after a full meal.
(3) By those suffering from ear disease (p. 135).
(4) By those liable to fits.
(5) By those suffering from heart or lung disease.
(6) By those who are deficient in proper healthy reaction of the skin (p. 123).
(7) By anæmic people.

Cycling.—Cycling is an admirable exercise.

Cyclists should always arrange the handles of their machines so that they can sit upright in the saddle, and in ordinary riding they ought always to ride with their backs as straight as possible. The position adopted in racing is bad, and should not be practised as a means of healthy exercise.

Tall, lanky people, with narrow or pigeon-chests, should avoid bicycling, so ought those suffering from rupture, *bad* varicose veins, or bladder troubles. Cycling, as an exercise for women and girls, appears to be doing great good. Care, however, must be taken in the choice of a saddle. On the whole, some form of seat is preferable to an ordinary saddle, and, with practice, the difficulty in balancing and steering is easily overcome. They should not choose a very high-geared machine, nor attempt heavy hill climbing. One great danger for beginners is the temptation to overdo it. Cycling, like all specialised exercises, requires much training. A beginner uses a vast amount of unnecessary force, and if he tries to do what a trained man has done, will surely injure himself. When a beginner gets a cycle, he must not buy a cyclometer, or the mileage craze will seize him, and he will overdo it.

Cricket, football, and similar games are excellent forms of recreation. Exercise is combined with mental and moral training. The fact of having to fight for one's side or club gives rise to a wholesome fellow-feeling, tends to extend the love of self to the love of one's fellows, and helps to make good men, good citizens, good soldiers, and good Britons. British patriots, and those who wish to see our country

continue to flourish and stand high among the other nations of the world should encourage with all their might such forms of sport and exercise.

CHAPTER XXIV

SLEEP

Periods of quiescence follow periods of activity. This is an almost universal law. All parts, all organs of our bodies obey this law. Thus, in the case of the heart, beat and pause succeed each in regular rhythm.

During rest reconstruction of used tissues still continues; in some forms of rest it is comparatively in abeyance, in other forms it is in full activity. In the latter case, the process of reconstruction has its period of quiescence at a different time from the rest of the more active manifestations of energy.

Sleep is the period of quiescence demanded by the brain. During sleep less blood goes to brain material and other structures connected with it. Substances already taken to it are being transformed into brain tissue and brain fuel.

In order to secure perfect sleep it is necessary to cut off stimulations conveyed by nerves to the brain from outside. These stimulations are:

(1) Light.
(2) Sound.
(3) Stimulations affecting skin—nerve endings (pp. 121).
(4) Taste particles.
(5) Smell particles.
(6) Stimuli from action of muscle fibres.
(7) Stimuli from alimentary canal, etc.

The above sensory stimuli excite activity in the various parts of the brain. A sensory impulse may be conducted to the brain and stimulate a portion of it without giving rise to any consciousness of its action on the mind of the individual whose brain it is affecting, or, on the other hand, it may so excite the brain that consciousness is awakened, and the individual is aware of the sensation.

An example of the above may be studied in the case of sound. The consciousness of sound, as in the case of all other forms of consciousness, depends upon, first, conditions outside the brain; second, conditions inside the brain. The conditions outside the brain are certain vibrations of an elastic medium acting upon the drum of the ear, and throwing it into vibration.

By means of a most elaborate and wonderful mechanical apparatus inside the ear these vibrations are conducted to the ends of a big nerve and set up a peculiar chemical action in them. This causes an impression to be conducted to the brain in a manner somewhat resembling in its results the conducting of a telegraphic message along a cable. The first

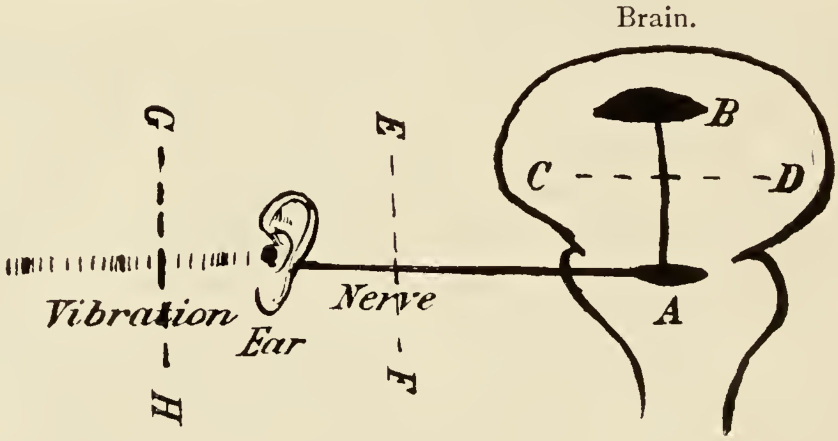

Fig. 35.

part of the brain stimulated is a purely sensory area. (A, fig. 35.) Stimulation of this area alone does not create perception of sound, although it may lead to certain movements. In order to make sound appreciable to consciousness, the impression must be conducted from A to B along other nerve fibres inside the brain. When the impression reaches B it sets up chemical action in little cellular structures, and this gives rise to consciousness. The principal object of sleep is to take the strain off consciousness, and, to a lesser degree, to relieve also the purely sensory areas of the brain. In order to attain perfect rest and thorough sleep, it is necessary to stop the conditions outside the brain that are one of the necessary conditions of consciousness. In the above example the best way to do this is to stop them outside the body altogether —*i.e.* to prevent vibrations of the elastic air from reaching the ear-drum, as diagrammatically represented in fig. 35 by the

dotted line G H. Thus perfect silence is an aid to sleep. It is, however, possible to attain a condition of unconsciousness even with external impressions stimulating the brain. The nervous impulse conducted along the nerve fibres to A (fig. 35) may stimulate this purely sensory area without affecting centre B, in which the second condition of consciousness, the action inside the brain, arises. The impulse is cut off, as shown by the dotted line C D. Any prolonged unvaried sensory stimulation acts at first on the consciousness-producing part of the brain, and then, after a while, ceases to act upon it, until some alteration is made in the monotony of the stimulation. In cases such as sound this cessation of internal part of consciousness does not always mean a cessation of the stimulation of the purely sensory part of the brain. Many people sleep in a room with a loud-ticking clock continually stimulating their sensory area for hearing. (A, fig. 35.) If the clock stops, the alteration of this sensory stimulation lights up chemical activity in the area of conscious activity, B, and they awaken. Similar experiences are gone through by ocean travellers in the case of the monotonous thump, thump, thump of the steamer's screw. Such sleep is not so perfect and refreshing as the sleep obtained by a thorough cessation from without of sensory stimuli. Part of the object of sleep is not obtained—*i.e.* the lower sensory areas are not rested. It is, however, immeasurably better than absolute sleeplessness, or the unnatural sleep produced by the poisonous action of drugs.

The conditions necessary for proper sleep are :

(1) Regularity as regards time.
(2) Proper amount of mental and bodily exercise.
(3) Proper food at right time.
(4) Rest to the sensory nerve endings.
(5) Mind free from thought.
(6) Proper position in bed.
(7) Abundant supply of fresh air.

Regularity is, of course, a necessary condition of sleep as of all functions of the body. It is advisable always to have stated hours of going to bed and getting up. The natural succession of day and night help the keeping of this law. The hours of darkness naturally remove one of the most powerful sensory impulses, and so lead to sleep at night time. Of course, with

practice and artificial darkness, habit can be set up and sleep taken during the daytime. In this way night nurses have to live in our great hospitals, their constitution becomes altered by habit, and when night nurses are down with fever the temperature is at its highest during the daytime, not at night, as is the case with those who sleep at night. The habit of thus turning day into night is not a good one for general health. The healthy stimulation of vital functions by daylight is missed in these cases (p. 143).

Proper amount of bodily and mental exercise favours sleep by making it necessary and bringing about in a natural manner the regular rhythm of work and sleep. If the mind alone be exercised sleep is not complete, as the muscles do not get proper sleep; and if the muscles are awake and the mind asleep sensory impulses from the muscles are sent up to the brain and disturbed sleep results (p. 145). Excessive exercise leaves many waste products in muscle or brain, and leads to sleeplessness. The waste products in the tissues act as irritants and rest therein is impossible. Achings in the muscles, sudden starts when falling into unconsciousness, worrying dreams about one's daily work disturb sleep. Hot baths at night are useful when this condition exists.

Proper food at night time.—Food should not be taken just before going to bed. Sensory stimuli from the alimentary canal keep the brain at work; nightmare of uncomfortable and alarming character is likely to be set up.

Rest to sensory nerve endings.—The importance of this condition has already been emphasised. The influence of the nerve endings in the skin and muscles are very important. Rest to these endings can be aided by hot baths, by avoiding irritating night garments (see p. 130), and by having well made, level beds.

Mind free from thought.—Many individuals of nervous, irritable temperament find this necessary condition for healthy sleep the most difficult of all to attain. This difficulty is often the result of bad habit. The patient has got into a way of reflecting in bed on his past or prospective work or amusements.

Sometimes it is the result of either an overworked brain laden with irritating waste products, or occasionally it is in consequence of an underworked brain craving for exercise.

Irregularity in hours of work and sleep frequently create a

difficulty of banishing thought at bedtime. Heavy mental work or worry just before going to rest is also a common cause of the trouble.

Many plans may be adopted to conquer the habit of thinking at night.

(1) Adopt absolutely regular habits.

(2) Try reading some very dry and uninteresting matter just before going to bed. A German grammar, for example, may serve as a good hypnotic.

Try, however, to avoid reading in bed, as the strained position of the eyes and the almost necessarily bad situation of the light are injurious to the sight. Moreover, when sleep is obtained the light is often left burning, and the purely sensory area for light in the brain is not rested, and the products of combustion injuriously contaminate the air of the bedroom.

(3) When in bed endeavour to turn the thoughts from worrying and exciting matters, and try to picture some familiar monotonous and sleepy landscapes. Thus, sleep may be obtained by imagining oneself by the side of some well-known rippling, murmuring stream. By concentrating the thoughts on such an imagination it presently assumes an apparently actual form, and gradually tones down into the spectre of a dream which in turn fades, and dreamless restful sleep supervenes. If successful in gaining sleep this way, future difficulties may be overcome, and when habit is fully established the mere thought of this scene at bedtime at once suggests sleep, and it follows, as a matter of course.

Above all things avoid despairing of sleep and jumping and turning about in wild irritation.

Tea and coffee should be avoided for four or five hours before going to bed, and should even then be indulged in to a very moderate extent.

Proper posture in bed.—During sleep the circulation through the brain is slackened. A certain degree of relative bloodlessness exists. The establishment of this condition is easier when the head during sleep is kept at a fairly uniform elevation above the body-level. Some regular pillow height should be adopted and kept to according to comfort. The difficulty felt by so many of sleeping in a strange bed frequently arises from the difference in the level of the head ; the sufferer should

try and arrange the pillows to as nearly as possible the same height as that to which he has been accustomed.

Sleeping on the back should be avoided. If food is in the stomach nightmare is more likely to arise from this position. Other pressure troubles may arise.

Abundance of fresh air.—Very bad air acts as a sleep producer, but the sleep is not natural; it is a stage of poisoning which if more intense would go on to death. On awakening from sleep produced in this way a sense of heaviness is felt and often severe headache. Moderately bad air may prevent sleep. In such cases one often wakes after an hour or two's sleep in consequence of the air becoming gradually bad. Probably the window and door are closed: the right thing to do is to open the window and go to sleep. If the window and door are kept closed unhealthy sleep may come as the air gets fouler. Bedrooms require strict ventilation. (See p. 45 *et seq.*)

The amount of sleep required varies with	Amount of work done. Individual peculiarities. Age.

The more work we do the more sleep we require. For an average adult doing an average day's work, eight hours' sleep are required. Some individuals, however, can do with less, some require more.

More sleep is required in old age on account of the greater time taken to repair the tissue waste. In old age it is well to economise tissues and strength, and to aid as far as possible the means of repair. This may be done by relieving the strain on our tissues as much as possible by sleep.

In childhood more sleep is required by the developing and growing frame. The average amount required by children is as follows:—

4	years old child	requires	12	hours' sleep.
7	"	"	11	"
9	"	"	$10\frac{1}{2}$	"
12-14	"	"	9-10	"
14-21	"	"	9	"

CHAPTER XXV

POISONS AND THE TREATMENT OF POISONING

ACCIDENTAL swallowing of poisons used for domestic purposes by the household sometimes happens. In such cases immediate treatment may be called for in order to save life. The medical man should be sent for without delay, and, whenever possible, the messenger must tell him what poison and how much of it the patient has taken, and also the age of the patient. In many cases, home treatment during the time that elapses between the taking of the poison and the arrival of the doctor may be instrumental in preventing death.

In most cases some substance has to be given to the patient in order to excite vomiting. There are, however, some cases of poisoning in which such vomiting is fatal. In most cases requiring an immediate emetic, the most suitable of the easily obtained emetics is mustard and water. From a dessert-spoonful to a table-spoonful, according to age, of powdered mustard is mixed with half a tumbler of water and given to the patient to drink. Tickling the throat with a feather may also be serviceable.

Strong Sulphuric Acid or Oil of Vitriol.—This is a very dangerous poison when taken concentrated, and gives most intense pain of a burning character in the throat and stomach, and the patient is doubled up by it. Sickness and great difficulty of breathing follow.

Treatment.—Emetics are not to be used.

If magnesia is in the house give patient an ounce of it in a tumbler of water. Failing the immediate administration of magnesia, half-an-ounce of chalk or whiting crushed and mixed with a tumbler full of water. If whiting is not obtainable, a similar dose of washing soda in plenty of water may be used. When none of these antidotes can be obtained the patient should be made to take copious draughts of water.

Strong Hydrochloric Acid or Spirits of Salts, or Muriatic Acid.—*Symptoms, etc.*, like sulphuric acid, with more choking and difficulty in breathing.

Treatment same as sulphuric acid.

Strong Nitric Acid, Aquafortis, or Red Spirit of Nitre.—*Treatment* as in sulphuric acid.

Oxalic Acid.—Symptoms—burning in mouth and stomach, followed by vomiting, often of blood. Cold sweats and heart failure follow, and sometimes convulsions occur before death.

Treatment.—Plenty of chalk or whiting should be given at once. If these are not attainable knock down the plaster from ceiling and cornices, pound it up and give it in water. Free draughts of lime water may be used.

Salts of Sorrel or Salts of Lemon.—Treatment, etc., same as with oxalic acid.

Caustic Potash and Caustic Soda.—Symptoms—burning in the throat and stomach, generally followed by vomiting, difficulty of breathing, and failure of heart, and death.

Treatment.—Emetics must not be used. Vinegar and water, lemon juice and water, or citric or tartaric acid and water should be freely and immediately administered.

Ammonia.—Pain in throat and stomach, great feeling of suffocation and distress in breathing.

Treatment same as caustic potash.

Phosphorus (match heads).—Poisoning is liable to occur from children sucking matches, and by the phosphorus paste used for killing rats.

Symptoms.—In acute case, onion-like taste in mouth, pains in stomach, followed by vomiting of tar-like matters, which sometimes shine in the dark. In less acute cases the symptom of jaundice and other troubles occur later, and go on probably to death.

If seen early enough the mustard emetic may be given. After the emetic, if there happens to be some of the disinfectant known as sanitas in the house, a teaspoonful of this in water may be given. Avoid fats and oils.

Saltpetre or Nitrate of Potash, or Salprunella Balls.—This substance in large doses is very dangerous. *Symptoms*—stomach pain, purging and vomiting, followed by convulsions, difficulty of breathing, failure of the heart, and death. The death has occurred in two hours, but is generally slower. A teaspoonful is a dangerous dose.

Treatment. — Mustard emetic at once. This should be followed by linseed tea and a little brandy. The patient must be kept warm.

Corrosive Sublimate and White Precipitate and Red Precipitate.—The above are the commoner salts of mercury that are liable to be accidentally taken.

Treatment.—Raw white of egg stirred up in water, or, if not at hand, a tablespoonful of flour in a tumbler of milk. This must be followed by an emetic, and, after it has acted, more egg, etc.

Lead Poisoning.—(1) Chronic lead poisoning is not uncommonly caused by articles of food. It gives rise to various symptoms, such as lead colic, lead palsy, anæmia, mental disorders, and fits.

Causes of Lead Poisoning.—Lead in drinking water from lead cisterns, cisterns repaired with white or red lead, lead pipes (rarely), pipes repaired with white or red lead, filters with lead fittings, syphons, and gasogenes with lead spouts and pipes.

Various acid wines, vinegars, ciders, etc., are apt to dissolve a dangerous amount of lead if stored in glazed earthenware vessels.

Foods wrapped in lead foil, lead taps of beer barrels, lead colours in sweetmeats, etc., lead shot left in bottles after being used to help to clean them, have all caused lead poisoning.

Tinned fruits may cause lead poisoning if taken in large quantities.

Workers with lead and lead compound should never take their meals in the room they work in, and great care must be taken to clean all trace of lead-containing matter from their hands and clothes before taking food. They should use flannel respirators when dealing with dusty lead work or fumes, and take occasional small dozes of Epsom salts.

Acute Lead Poisoning.—Sugar of lead, etc. Give emetic, and follow it by dose of Epsom salts.

Zinc Chloride, "Burnett's Disinfecting Fluid."—After the vomiting caused by this poison, white of egg in milk should be freely given, and also some carbonate of soda dissolved in plenty of water.

Chloral Hydrate.—Accidents have occurred through the highly dangerous, and always in the end deadly, habit of taking this drug.

When an excessive dose has been taken, mustard emetic should be given at once, and throat tickled with feathers. The patient should be well flicked with a wet towel to rouse him from the sleep into which he falls, strong coffee should be administered after the emetic has acted well. Strong smelling salts should be breathed occasionally, and cold water squirted into nose.

Opium.—Laudanum is the most common form in which this poison exists in households, and therefore is not an uncommon cause of accident. Opium also exists in most of the common cough mixtures.

Opium even in small doses acts very powerfully on children, and serious accidents may occur from giving a child a doze of cough mixture intended for an adult.

Opium usually causes a variable period of excitement, followed by drowsiness, going on into a sleep from which the patient cannot be roused, and death supervenes.

Treatment as in chloral hydrate.

Strychnine.—This is the active principle of the nux vomica bean; it is a most intense poison.

It is a common constituent of rat poison. The symptoms come on rapidly, and death generally occurs within two hours.

Emetics should be given at once. Tobacco and water is a good emetic to give, as the tobacco acts as an antidote.

Carbolic Acid.—Great pain, followed by interference with breathing, convulsions, and unconsciousness are prominent symptoms.

Vomiting must be caused as soon as possible; oil and milk drinks should be given afterwards.

Mussel and other shell-fish poisoning.—This is due to a bacterial germ from sewage getting into the mussel. A poison is produced that is sometimes fatal to people eating the mussels.

Generally a feeling of pins and needles is felt in the hands; this is followed by giddiness, dryness of the throat, colicky pains, diarrhœa, loss of sight, and unconsciousness, and death.

Treatment.—Mustard emetics should be given at once, mustard poultices and hot fomentations over the stomach and back of neck, and stimulants are required.

Poisonous Mushrooms.—Various symptoms are produced by this class of poisons, such as severe colicky pains coming on some time after the meal; these pains are usually followed by nausea and vomiting, and then diarrhœa, and in many kinds the patient sinks into an unconscious state. The danger to life continues for about three days.

Treatment.—Mustard emetic at once, and follow this with a dose of castor oil.

APPENDIX

A List of some of the more Valuable Works on Health and Allied Subjects likely to be of value to Readers of this Book who may wish to extend their Studies.

A—*Popular Books on Hygiene*

"Book of Health," edited by Malcolm Morris, F.R.C.S., published by Cassell. A large work, containing articles on different subjects by leading authorities.

"Dangers to Health," by T. P. Teale, M.D., etc. A splendid collection of plates, showing in a most graphic manner sanitary faults found in dwellings and water supply.

"Our Homes," edited by S. F. Murphy, published by Cassell. Contains excellent articles by leading authorities on architecture, sanitation, building, etc.

"Hygiene," by Arthur Newsholme, M.D., etc., published by Swan Sonnenschein & Co. An excellent and clearly described work, suitable for science and art examinations.

"Hygiene," by J. Lane Notter, M.A., M.D., etc., published by Longmans. A similar work to the above, and also suitable for science and art examinations.

B—*Technical Works, but still suitable for Non-technical Readers of General Hygiene*

"Hygiene and Public Health," 3 large vols., edited by Stevenson and Murphy, published by Churchill.

"Handbook of Hygiene," by G. Wilson, M.A., M.D., etc., published by Churchill.

"Hygiene," by Louis C. Parkes, M.D., etc., published by H. K. Lewis.

"Hygiene," by B. Arthur Whitelegge, M.D., etc., published by Cassell.

C—*Works on Special Subjects*

"Chemistry of Cookery," by W. Mattieu Williams, F.C.S., published by Chatto & Windus.

"Foods," by Edward Smith, M.D., etc., published by Kegan Paul.

"Food and Feeding," by Sir Henry Thompson, F.R.S.S., etc., published by F. Warne.

"Physical Education" (reprints from Stevenson and Murphy's "Hygiene"), by F. Treves, F.R.C.S., published by Churchill.

"Skin and Hair" (reprints from "Book of Health"), by Malcolm Morris, F.R.C.S., etc., published by Cassell.

"Philosophy of Clothing," by W. Mattieu Williams, F.C.S., etc., published by Laurie.

"School Hygiene," by A. Newsholme, M.D., published by Swan Sonnenschein & Co.

"Nursery Hygiene," by Louis Starr, A.M., M.D., published by H. K. Lewis.

D—*General Physiology*

"Huxley's Elementary Physiology," published by Macmillan.

E—*Work that ought to be Possessed and constantly referred to by Builders, and all Members and Officers of Sanitary Authorities, and most Householders.*

"Knight's Annotated Model Bye-laws," published by Knight & Co. An official work containing the model bye-laws of The Local Government Board on various subjects, with excellent explanatory clauses and diagrams.

INDEX

W. H. WHITE AND CO. LIMITED
RIVERSIDE PRESS, EDINBURGH